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## Art. XXXI.—*Review of the Annual Report on the U. S. Coast Survey.**

The annual report of this important national work, interesting alike to the man of science, to the sailor, and the philanthropist, has just been published; and in accordance with our intention of keeping our readers informed of the state of the survey, we purpose to give a brief account of the operations during the past year, dwelling particularly on those points which are more generally interesting in a scientific point of view.

*Plans and Operations.*—The general plan for the more rapid extension of the survey presented in the previous reports of the superintendent, has been prosecuted with the continued success which it promised at its commencement. This plan, it will be recollected, consists in dividing the whole of our extended seaboard, including that of the Gulf of Mexico, into nine nearly equal portions, and in prosecuting the work in each of these separately and simultaneously. This plan will enable the survey to be accelerated as rapidly as the appropriations by Congress for the purpose will permit, and it will produce immediate results in the way of the examination of harbors and channels, of the highest importance to commerce. It also furnishes the means of introducing a uniform system into every part of the survey, the

* Report of the Superintendent (Alexander D. Bache, LL.D) of the Coast Survey, showing the progress of the work during the year ending October, 1847. (Senate Document, 30th Congress, 1st Session, Executive No. 6.) pp. 88, 8vo.

In our last number (p. 299) we barely announced the appearance of this Report, and cited a few paragraphs relating to the general results of the past year's survey.

importance of which, in reference to economy and accuracy, must be manifest to all acquainted with operations of this kind.

That detached surveys conducted upon different plans and principles cannot produce a satisfactory map of a country, has been proved as often as the project has been tried. The head of the work should have constantly in his mind a distinct plan of the whole, leading to definite final results; he should be allowed full scope in the development and prosecution of this plan in all its parts, in their proper order of succession; and then and only under this condition he should be held responsible for the quality and the rapidity of the execution. The plan proposed by Dr. Bache has met the approbation of the head of the department under which he acts, and has received the support of Congress for three years past. Even the existence of the war has not prevented the increase of appropriation which has been called for by the continued extension of the operations. The superintendent has also been liberally aided by the head of the navy department, and has thus incurred the responsibility above alluded to. The manner in which he has met this during the past year is shown in the report before us. It exhibits an improvement in the quality of results, and an increase in quantity over that of the former plan, which may be estimated at double the amount for an increase of fifty per cent. in the cost.

In accordance with this plan the field work was extended during the year 1844 into nine states, and the summer of 1845 into thirteen, in 1846 into fifteen, and during the past year into eighteen, namely, Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana and Texas. The estimate for the next year will provide for operations in every state on the coast of the Atlantic and Gulf of Mexico.

The chief part of the operations in one of these sections, namely, that from Point Judith to the Capes of the Delaware, is completed, and the work has made very considerable progress in two others, viz., in the section of New England and that embracing Maryland and Virginia. The triangulation was commenced in 1844 in a fourth section (North Carolina), and in 1845 in a fifth section, Alabama, Mississippi and Louisiana. The reconnoissance preliminary to the triangulation was made in 1847 in South Carolina and Georgia and in Texas. When the work is commenced in any section it is gradually extended as the introductory operations prepare the way for others, a reconnoissance being succeeded by a triangulation and by astronomical determinations, and these by the topographical survey with the plane table and by soundings and other hydrographical operations.

*Measurement of a new Base Line.*—During the past year the measurement of a new base line nearly seven miles long, has been made by the superintendent in person, after a reconnoissance by F. H. Gerdes on the Gulf of Mexico. The principal novelty connected with this measurement relates to the base apparatus; the general plan of which was devised by Dr. Bache. The measuring bars were upon the compensation principle, first employed we believe in operations of this kind by Colonel Colby in Great Britain, and by Mr. Borden in this country; but the method of obtaining the compensation was entirely different from that used by these gentlemen, and served to remove a cause of error which has been strangely overlooked in the different applications of the compensating arrangement as usually employed. A bar of brass and of iron of the same dimensions and exposed to the same source of heat, will not arrive at the same temperature in the same time; the rapidity of change will depend upon the difference of conducting power, the difference of specific heat, and the state of the surface as to its absorbing power. Hence though two bars of different metals may show the same length at two different temperatures, yet in the transition from the one temperature to the other, they will exhibit different lengths. To remedy this defect, the surfaces of the different metals were brought into the same absorbing condition by coating each with the same material, and the bars were made to attain the same degree of temperature in the same time, by increasing or diminishing the transverse section until the desired effect was produced. This apparatus was constructed in 1845, and first used with microscopes in the autumn of that year, and is briefly referred to in the report of November following.

"Having arranged the sections approximately," says Dr. Bache, "using numbers taken from the books, the changes in length during the increase or the decrease of temperature were not perceived when microscopes were used, supported upon wooden stands, or even upon stone blocks of small size; the means of measurement were not sufficiently delicate to detect them, or they were masked by greater changes in the supports. When the level of contact was substituted for the microscopes, or when Mr. Saxton's reflecting pyrometer was employed, these changes became very perceptible, and it was necessary to resort to direct experiment upon the material of the bars themselves to obtain even approximate compensation, and there to correct a small residual quantity by applying a covering more absorbent of heat to one bar than the other. If such changes have not been perceived hitherto, it has been because inadequate means were used to detect them. I am indebted to Lieutenant A. A. Humphreys and to Mr. Joseph Saxton for the perseverance and skill with which the experiments necessary to a complete adjustment of the apparatus were made."

The lever and level of contact first used, I believe, in the adjustment of standard measures by Bessel, was applied to indicate the lengths of the bars. The levels were so delicate, that several divisions upon them made up a quantity entirely insignificant in the measurement. The doubt which I had was, whether the sensibility of the apparatus had not been carried too far. This was, however, entirely removed, upon finding the rapidity and certainty with which it could be used. The contact of two adjacent measures was between a blunt knife edge and a plane of agate.

"The trussed support for the bars adapted to bearing the apparatus at two points only, and the tin covering or tube which surrounded the whole, were similar in principle to those used by Mr. Borden, but differed entirely in the adaptation of them; the bars moved freely on the trussed frame upon rollers, and were not attached to the covering tube in which the trussed frame itself was merely supported. The tin covering was conical and was doubled."

"The trestles admitted of the various motions required in placing the apparatus. The length of the whole, about twenty feet, (six metres,) gave a weight which permitted easy and rapid transfer by four men, when covered with several thicknesses of imperfectly conducting material to keep the fluctuations of temperature within moderate limits. In arranging so many and various details, it is not to be expected that some of them will not admit of improvement; but the performance of the apparatus was highly satisfactory, working with a rapidity and accuracy quite beyond my most sanguine expectations, and making comparatively light the labor of all concerned in the excitement produced by expectations constantly surpassed. The contacts were usually made in much less time than the setting of the forward trestles for the next measure. The following statistics of the measurement will suffice for the present, to show that we have obtained a useful auxiliary in a geodetic survey, especially when the difficulties of triangulation render advisable the measurement of frequent bases."

"The greatest length measured in the course of a day, in the final measurement, was one hundred and eighty-three tubes, equal to nearly seven-tenths of a mile; the least, forty-seven tubes, or one-fourth of a mile; the average, one hundred and four tubes, or four-tenths of a mile. The whole measurement of nearly seven miles was completed in seventeen working days, not reckoning the time lost by bad weather, or occupied by change of camp, and by comparisons of apparatus. The length of the apparatus was compared before and after final measurement with a standard iron bar, with which it had been compared in the office, by using Mr. Saxton's reflecting pyrometer."

"The accuracy with which a remeasurement of considerable length could be made, was tested more than once in the measurement, but it was determined to make a more complete direct trial by establishing intermediate marks, and noting by the micro-telescopes attached to the ends of the bars the deviation at intervals. The greatest deviation in the length of seventeen tubes was between one and two hundredths of an inch; the average in twelve cases of repetition, not regarding signs, was five thousandths of an inch, the final error at the end of the third of a mile remeasured was nothing. The probable error of remeasuring one hundred and twelve yards was five thousandths of an inch, making in the whole seven miles of the length of the base, and supposing all the errors to fall in the same direction, which is physically most improbable, about five-tenths of an inch."

*Astronomical Observations.*—Within the last two years a number of new astronomical instruments have been procured; among these a zenith telescope, which has been used for obtaining the latitudes by the method invented by Capt. Talcott. This consists in observing the differences of zenith distances of stars culminating within a short distance of each other, and at nearly the same altitudes on different sides of the zenith. The publication of the new Catalogue of Stars by the British Association, gives great facility in the use of this method, as well as accuracy in the results. At one station the mean probable error of a single determination, as deduced from the comparison of the several individual observations, was but four-tenths of a second of space, and at another but one-tenth. All the astronomical and other observations have been reduced to a system, in which numerous individual observations are scrutinized, and the limit of errors obtained by the method of least squares, which is now constantly used as a part of the plan of observation. By means of it the different instruments, which have on any occasion been used at the same place, can be compared, and in this way the superiority of the zenith telescope, as far as the comparison has yet been made, is rendered manifest. At the close of the year the comparison was going on between this instrument used in the way we have mentioned, and that of a new zenith transit, similar to that devised by Professor Airy, and used on the survey of Great Britain according to the method of prime verticals. We may expect in the report of next year, to find an account of the results as to the comparative value of the two instruments. The advantages in the use of the zenith telescope over instruments hitherto generally used in the field, are, ease of application, a high magnifying power, and the employment of a microscope.

An astronomical station has been established at Nantucket, which is an important position on account of its being the southern extremity of the longest arc of the meridian to be found on

the New England coast. Observations have been assiduously continued at this place by Wm. Mitchell, Esq., and his assistant. His method of determining the longitude by chronometers between Boston and Liverpool, has been continued by William C. Bond, and fifty-two results from twenty-three chronometers have been reported.

The use of the new instruments has served to verify a remarkable conclusion arrived at in the observations of a former year. In places near each other, and where the plumb line cannot be influenced by the attraction of mountains, the latitudes derived from geodetical and astronomical data, do not agree with each other, or in other words, the difference of latitude of two places in the vicinity of each other, is not found the same when derived from the triangulation between the two places and from separate astronomical observations. The latitudes of New York and Boston do not agree when compared by the two methods. Boston, Cape Henlopen and New York differ from Philadelphia; and the various stations about the city of New York, when transferred to a central point, are all at variance with each other. This result, intimately connected with the questions of geology and the figure of the earth, was first announced in this Journal in 1845, and was referred by Dr. Bache to irregularities of gravitation occasioned by variations in the form and density of the material composing the crust of the earth. A discovery of the same kind has since been made by Major General Colby, in the ordnance survey of Great Britain, apparently without the knowledge of the previous discovery on the survey under the direction of Dr. Bache.

*System of Computation for Longitude, &c.*—Dr. Bache early introduced a system of computation made by persons not employed in the field of operations. These computations consist of reductions and verifications of the observations of the triangulation of the azimuth and of the latitudes, and also of the discussions of occultations, eclipses, and other celestial phenomena which have been observed, and may serve for the purpose of ascertaining the longitude of the principal points of the survey. In the former work, Mr. Nulty and Mr. Werner are employed, and in the latter, Lieut. Gilliss and Mr. Sears C. Walker. The American observations collected by the last named gentleman for the determination of the longitude, embrace no less than five hundred occultations, and one thousand moon culminating stars. The European observations for comparison with these, amount to nearly two thousand. During the past year, Mr. Walker has also been engaged in reducing a portion of the extensive series of eclipses and occultations observed by W. C. Bond, Esq., which embrace all the phenomena of this kind which were visible at Dorchester or Cambridge during a period of twenty-seven years. Lieut. Gilliss has been engaged in the comparison of the longi-

tude of Washington, Hudson and Dorchester, with those of the European observations of Cambridge, Greenwich, Edinburgh, Hamburgh, Copenhagen, Kremsmunster and Cracow. The corresponding observations in this country and Europe, in the year 1839, furnish 428 differences of longitude.

*Use of the Magnetic Telegraph for Differences of Longitude.*—The employment of this method of ascertaining longitude during the past year, has proved entirely successful between Washington, Philadelphia and Jersey City, opposite New York. Lieut. M. F. Maury again directed the coöperation of the National Observatory; the operations at Philadelphia were under the direction of Professor Kendall, and those at New York under Prof. Loomis. The details of the observations were arranged by Assistant S. C. Walker of the coast survey. The principle of this method consists in transmitting signals from one station to another, and these noted by a time-keeper well regulated to the time of the place; the difference in the times gives the difference in longitude expressed in time.

"The signals are given at one of the stations by pressing a key, which causes a closing of the circuit. This closing it is intended shall be simultaneous with the ticking of a clock or chronometer at the station. The circuit being closed, if the electrical wave or current takes a sensible time to propagate itself, or to pass from one station to another, the absolute time of the signals reaching the second or receiving station, is sensibly different from that of making the signal at the first or giving station. A coil about the poles of a horse-shoe magnet of soft iron, forms part of the circuit through which the electrical effect is transmitted. Under its influence the soft iron becomes magnetic, attracting the soft iron bar (armature or keeper) delicately poised at a determined distance from the poles of the magnet; the movement of this keeper sets in action a local battery, which gives sufficient power to make the dots and lines constituting the Morse telegraphic signals.* The click of the keeper of this temporary magnet is compared at the receiving station, with that of a clock or chronometer, thus marking the time at which the signal, made at a known time at the giving station, is received. From this explanation, it appears that there is liability to error: 1. In the clock times at the different stations. These are easily examined, and the most probable times assigned at each station, the personal equation for clock correction being determined and allowed for, they may be treated as if only very small errors existed. 2. The time of striking the trigger or key, to close the circuit, may not coincide with the clock beat. The error, if any, from this source is determinable by experiment; and careful experiment failed to detect a

* See a figure of this apparatus, in this volume, p. 56.

sensible amount. 3. The electrical effect may take a sensible time to be transmitted, and this may be known, if other sources of error could be got rid of, by transmitting signals from an eastern to a western station, and vice versa; and it may be rendered null in its effect upon determinations of differences of longitude by such alternate transmission, or it may be examined in its combined effect with the next error. 4. That of the sensible interval, if any exist, between the activity of the coil, its action in inducing magnetism in the receiving magnet, and the click of the keeper of this magnet. 5. The error in noting the fraction of a second as denoted by the clock. It was perceived that this difference in the estimate of fractions of a second, rendered the transmission of signals, by the beats of a well regulated sidereal clock, and their reception by another sidereal clock, of little avail, the time falling constantly upon the same fraction of a second. The transmission of signals, by beats of a mean solar chronometer, and the marking of the time of reception by a sidereal clock or chronometer, carries the fraction of the second over every part of the whole second, and once, at least, in ten minutes marks the coincidence of the beats of the two time-keepers. By observations of the coincidences, and the marking of intervals at the same station, the law by which each observer varied in the estimate of fractions of a second became known, and, of course, the differences (or receiving personal equations) of each observer, supposing them to be constant. Pains were taken to compare personal equations by all the observers. It turned out, finally, that this might have been done by transmitting signals; but, then, to have assumed it would have been to anticipate a result which was sought. The part of the error, then, of receiving signals from error of noting time, was ascertained numerically, and its value could be assigned within certain limits in any case. The inference is drawn from an examination of this class of personal equations, 'that when the two clocks' (the one by which signals are given, and the other by which they are received, both being rated either to mean, solar or sidereal time) 'do not coincide in their beats, the observers on the average set down the fraction of a second of the signal received too small.' Of the five errors, then, which have been enumerated, the numerical values could be assigned to two, (viz. 1 and 5,) and one (viz. 2) was insensible. After assigning the values in any particular case to 1 and 5, there remain residual errors, caused by 3 and 4. Now, it is plain that both of these will affect the result alike; that is, will tend to make the time of receiving the signal later than it should be by the amount of retardation of the wave current, and by the difference in the time of its reaching the spiral coil and the click of the keeper of the receiving magnet. But a comparison of the observations shows a very small residual quantity having just the

opposite sign, the signal being apparently received earlier than it was given. From this, the nullity of both these corrections, 3 and 4, is fairly inferred, and the interesting consequences follow, that 'the telegraphic method of comparing clocks, distant two hundred miles from each other, is free from error when the method of coincidence of beats is employed, and that the probable error of the longitude, from this method, is the same as the mean result of the computed relative correction of the clocks for the nights of observation.' An investigation of the probable value of such error shows that, under favorable astronomical circumstances, and with due care in the use of the transit instrument, 'the astronomical difference of longitude, between any two stations of a trigonometrical survey, may be determined by telegraphic signals, with a degree of precision of the same order as that of difference of latitude,' the inaccuracy depending upon the same causes as the deviation of the plumb-line."

*Magnetic Observations and Instruments.*—Observations for determining the variation, the dip and intensity of magnetism, are made at the more prominent points of the coast survey, and the instruments used for variation and intensity, are those invented by Weber and Lloyd and modified by Lieut. Riddell. They consist of a portable declinometer, with its theodolite apparatus for deflections and vibrations. This apparatus was here first used under the immediate direction of the superintendent, and also at numerous detached stations by two assistants, Capt. I. J. Lee and Mr. R. H. Fauntleroy, and by two of their aids, and has been approved in every case by these gentlemen as convenient, and whenever the azimuth lines of the survey could be used, as giving accurate results. It was also used by Prof. Renwick and Dr. Locke, but whether approved or not we do not know. We mention this particularly, because we have learned from a distinguished observer abroad, that there is a disposition in England to return to the use of the older methods, which is certainly not warranted by the experience of the observers of the coast survey.

The magnetic observations near the city of Baltimore indicate that this region is one of considerable local attraction.

*Maps of the Coast.*—It is stated in the Address of the President of the Astronomical Society of London, that a specimen of the new map of England indicates that it has advanced as much upon its predecessors, as its predecessors had upon all other maps. The qualities which indicate this advance, we learn from the same Address, are: 1st. That the map is upon the scale of $\frac{1}{10560}$, or six inches to the mile. 2d. That its details include every thing of topographical value which can be placed upon a map embracing the traces of the lines of equal heights. 3d. The latitudes and longitudes are graduated not to degrees, as on common maps, nor to minutes, as on the largest maps on which we

have been accustomed to see graduations, but to single seconds of arc, each of these seconds occupying one-tenth of an inch. The latitudes have been determined from numerous observations with the zenith section, and the difference of longitude of two exterior points, by the transportation of chronometers.

We are here presented with a test of quality which may be applied to the maps of our coast survey. 1st. The scale adopted by Mr. Hassler for the details of the maps was $\frac{1}{10}\frac{1}{00}\frac{1}{00}$, or a little less than six inches to the mile. As the object of the work is to combine a chart for navigation with a map of the coast, this is too large for practical use except in the case of isolated harbors, and was with propriety reduced to the scale of the great map of France, that of $\frac{1}{80}\frac{1}{00}\frac{1}{00}$. The detail and beauty of execution of the American sheets, greatly surpass those of the celebrated map just mentioned. 2d. The system of topographical details introduced by Dr. Bache, secures uniformity in the representation of the ground and includes all that is alluded to in the foregoing account. The horizontal curves drawn at regular vertical distances, are marked in red, and the system of hachures adopted, is modified from that of Lehman. 3d. The scale admits of the same subdivision as those of the British maps; the numerous determinations of latitude resulting from the discovery before referred to in regard to discrepancies of the geodetic and observed latitudes of near stations, are reduced to central points by the geodetic results; the determinations of difference of longitude made by the electro-magnetic telegraph, give materials of the same kind and quality as those alluded to in praise of the transatlantic maps. In the case of the longitudes, the operation of which is still in progress, a method is employed a step in advance of those abroad.

The large plates of copper on which the charts are delineated, are produced in a finished state ready for the engraver by means of an electrotype process. Also, the same principle is applied to multiply the plates after they are engraved, so as to increase indefinitely the number of impressions which may be obtained while the original plate remains uninjured.

*Explorations of the Gulf Stream.*—In the last report an account was given of a series of observations on the Gulf Stream, made by Lieut. Geo. M. Bache, whose life fell a sacrifice to his zeal in the discharge of his duty, and whose loss science was called upon to mourn just as he was commencing with his accustomed ardor, the investigation of one of the most interesting phenomena of our globe. The results he obtained will be given to the world in another publication, and it will be sufficient for us to state in this place that he examined three entire sections across the stream. His researches exhibit the remarkable fact, that the whole current of warm water to the depth of at least four hun-

dred and eighty fathoms, divides itself into two principal branches, separated by a portion of cold water, and that the transition from the cold water, along and next to the coast is almost instantaneous, as if the two were separated by a nearly perpendicular wall, slightly inclining to the east at the top. The plan of operation, commenced by Lieut. Bache, has been continued during the past year, and a series of observations on the temperature at different depths has been made across the stream off the coast of Virginia, North and South Carolina, Georgia and Florida, for the purpose of comparison with those made the year before across the same places and to ascertain what changes may have taken place. The results are highly interesting, the same general phenomena are presented as in the former survey, two principal divisions of the stream are observed, but these show a tendency in the last survey to separate into others, the points of maximum temperature are not in the same places and the mean or average temperature is different. The investigation becomes more interesting as it is farther pursued, and we doubt not the superintendent, with his love for physical science, will not fail to direct such observations as may lead to a more definite knowledge than we now possess of this interesting phenomenon of the ocean.

*Changes in Channels and Shoals, &c.*—One object of the coast survey is to ascertain the character and direction of the changes which may be going on in different parts of the coast, to provide the means of observing them in future, and to furnish the data on which the plans of controlling them may be founded. During the past year the changes in the Delaware River near the Pea Patch have been examined, and were found to consist in the closing of the old eastern channel by the extension of the Bulkhead shoal to meet the spit, extending from the upper part of the Pea Patch island. At the same time, the new eastern channel has widened and deepened. These changes have been accurately marked on the map of the coast survey, which will thus furnish the means of discovering any future alteration. In this way the records of the coast survey will afford the data for solving problems of a most interesting character, as for example, the rate of increase of the delta of the Mississippi.

*Tidal Observations.*—A series of observations on the variation of the height of water and the currents produced by the tides have been established at different points along the coast. The observations made at Old Point Comfort have been discussed by Lieut. Com. Davis, U.S.N., under the immediate direction of the superintendent, for the purpose of ascertaining the effect of the variations in the moon's parallax and declination. In eliminating the effects of these, the oscillations caused by atmospheric changes appear as residual errors. The effect of change of pressure and of wind on the height of water is already apparent, and

the continuation of the operations will, in due time, afford data for the formation of a prediction table of the time of the phases of the tide. In the continuance of these observations, valuable data will be furnished for studying the phenomena of the oscillations of the ocean.

*Collections of Specimens from Soundings.*—The charts of the coast survey exhibit a perfect representation of the character and configuration of the bottom of the ocean within a certain distance from land. The idea occurred to Lieut. Bache in 1842, to form a collection of all the different materials obtained in the sounding operations, and he accordingly commenced reducing this idea to practice by placing in small bottles, duly labeled specimens of all the materials found at the bottom. It was the intention of this lamented officer to form a large geological map by glueing on the surface of a suitable chart the several substances contained in the bottles, in their proper order and thus at one view to present to the eye the means of generalizing the geological phenomena of the submarine formation. The plan of a map of this kind has not yet been carried into practice, but the collection of the materials of the bottom has been continued.

Besides the formation of the map above mentioned, the microscopic examination of these specimens could scarcely fail to develop some interesting facts, which might prove of value to navigation as well as of importance to science. Accordingly, specimens of the materials of soundings were submitted to Professor J. W. Bailey of West Point, who kindly undertook the examination of them. He finds that all the deep sea soundings are of the highest interest, being filled with organisms, particularly with those of the calcareous polythalamia, to an amount that is really amazing, hundreds of millions existing in every cubic inch. The specimen from latitude 38° 04′, longitude 73° 56′, from the depth of ninety fathoms, is crowded with remains, mostly large enough to be recognized by a practised eye without the aid of a magnifier. The forms which occur at different depths and in different places are so various, that they might serve to identify the position of the mariner and thus furnish another illustration of the fact that branches of knowledge apparently the farthest removed from utility are frequently found applicable to the useful arts of life. In this connection it may be mentioned that Professor Agassiz has accompanied Capt. Davis in his hydrographical operations connected with the coast survey, and has reaped a rich harvest of discovery relative to the animals which inhabit different depths of water. Every few feet of increase in the depth give changes in the character of organized beings which inhabit the ocean.

ART. XXXII.—*On Philosophical Induction;* by SAMUEL TYLER.

IN the January number of this Journal, Mr. J. D. Whelpley remarks upon "the true method to be adopted in the scientific study of nature;" and calls it, "*induction by analogy.*"

Mr. Whelpley has touched upon one of the most difficult topics involved in the method of investigation. There is no problem in the whole scheme of logic, that has given philosophers more trouble, than to ascertain the true nature of analogy, and to fix its precise relation to induction. I know of no question, about which there is more confusion of thought in the best writers upon logic and evidence. I will therefore endeavor to exhibit a succinct analysis of the subject matter.

Induction is very different from the reasoning or deductive process, in which the conclusion is necessarily assumed in the very conception of the premises, as is seen in its formal exhibition in the syllogism. Induction may be defined, a process of investigation and of collecting facts and phenomena, either with or without a view to establish some general principle already suggested to the mind. It is manifest, that the mere investigation and collection of facts and phenomena, *without* a view to establish some general principle already suggested to the mind, is not the reasoning process. It therefore only remains to examine the other, the investigation and collection of facts and phenomena, *with* a view to establish some general principle already suggested to the mind. In this last case, the investigation and collection of facts and phenomena, is conducted on the supposition or presumption of the existence of a general principle or law; and is directed with a view to establish it, by the examination of a sufficient number of facts and phenomena. For example: a naturalist, on seeing for the first time a duck or any other water-fowl, might be led to infer that all water-fowl have web-feet; and might therefore proceed to search for other water-fowl, until he found the goose, the pelican, the swan, &c.; and would then be convinced of the truth of the general principle, that all water-fowl have web-feet. Now, this is certainly not the process of reasoning; for it is conducted upon the supposition or presumption merely, of the existence of the law or general principle, and not upon the absolute certainty of its existence; for it would then not be investigation, but demonstration, or reasoning from known premises to something taken for granted in those premises, as is always the case in the reasoning process. The inductive process therefore, is not governed by principles of logic, but by principles of evidence. As in the example above, the naturalist supposed from the fact that one water-fowl, the duck, has web-feet, that all water-fowl have web-feet: which is evidently a mere supposition

from testimony not sufficient to convince the naturalist: he therefore searches for other water-fowl (other testimony), and finds the goose, the pelican, the swan, &c.; and is convinced by this accumulated testimony, of the general principle, that all water-fowl have web-feet. The mental determination is effected by testimony, and not by rules of logic. The conclusion is not implied in the very conception of the premises, as is always the case in reasoning; but it is warranted by the probabilities founded in the analogies of nature, and in the constitution of the human mind, which compels us to draw the inference from the analogies. As for instance, in the example of an inductive search for a cause, which is given by Sir John Herschel in his Preliminary Discourse on the study of natural philosophy:—"Suppose dew (says he) were the phenomenon proposed, whose cause we would know. In the first place, we must separate dew from rain, and the moisture of fogs, and limit the application of the term to what is really meant, which is the spontaneous appearance of moisture on substances exposed in the open air, when no rain or visible wet is falling. Now, here we have analogous phenomena in the moisture which bedews a cold metal or stone, when we breathe upon it; that which appears on a glass of water fresh from the well in warm weather; that which appears on the inside of windows, when sudden rain or hail chills the external air; that which runs down our walls, when after a long frost, a warm moist thaw comes on: all these instances agree in one point, the coldness of the object dewed, in comparison with the air in contact with it. But in the case of the night dew, is this a real cause? is it a fact, that the object dewed is colder than the air? Certainly not, one would at first be inclined to say; for what is to make it so? But the analogies are cogent and unanimous, and therefore we are not to discard their indication; and besides, the experiment is easy: we have only to lay a thermometer in contact with the dewed substance, and hang one a little distance above it, out of reach of its influence. The experiment has therefore been made; the question has been asked, and the answer has invariably been in the affirmative. Whenever an object contracts dew, it is colder than the air." Here it is seen, that the whole process is founded on analogy. The analogous instances were the evidence that lighted up the path of investigation. And though it is given by Herschel as an example of inductive search, without any view to the doctrine which I am expounding, yet the analogies are pointed out as distinctly, as if it had been written for the very purpose for which I am using it. And this is a fair example of inductive search, and points out the true relation of analogy to induction—indicates its function in the process. It shows that analogy is the evidence on which the inductive process is conducted. The truth is, all the evidence on which the inductive process is con-

ducted, may be divided into analogy and identity; though of course, subordinate divisions may be made of these. For example: a child that has been burnt by the flame of a candle, will expect the *same* effect from the *same* cause—*to be burnt* by the *same* candle. This expectation is founded upon *identity* of evidence. But when the child expects the *same* effect from a *similar* cause, as for instance, *to be burnt* by the flame of *another* candle, (though this may almost be called the *same* cause,) or by the flame of wood, or gas, or by every flame, the expectation is founded upon analogy. Whenever the inference is from *same* to *same*, it is founded upon identity; and whenever it is from *like* to *like*, however great the likeness, it is founded upon analogy. It is clear then, that induction beginning with the simplest classifications is founded upon analogy. As long as the subject of investigation is merely probable, no matter how great the probability, the process is founded upon analogy. As in the case of the theory of dew, the whole process was founded upon analogy, until it was ascertained by experiment with the thermometer, that cold was the cause, and thus all the instances were identified. And in every science, we must proceed upon analogous instances, until we arrive at a common cause or law. This is the true method, and by it we can push our researches to the utmost verge of reasonable supposition; for the analogies are the harmonies of the universe. But the moment we depart from analogy, and begin to feign causes which are not known to reside in any ascertained instance, then we are on the boundless sea of mere conjecture.

Although we have thus pointed out the function of analogy in the inductive process, an important point still remains to be explained: the nature of analogy itself.

The conviction produced by analogy between facts or phenomena, has the same foundation for its verity, that the conviction of the existence of the most familiar object has. Both convictions are founded on our mental constitution, on what metaphysicians call fundamental laws of belief. If we see an object, we cannot but believe in its existence: so if we perceive an analogy between phenomena, we cannot but believe, that they are produced by a similar or common cause. But why the conviction is produced in either case is not known, and never can be, in this state of existence. It is beyond the boundaries of philosophy. Analogy is therefore clothed by nature, with the power to produce conviction in our minds solid enough to be the foundation of inductive inference. Some philosophers, not understanding the nature of the inductive process, and confounding philosophical analogy with rhetorical analogy, have supposed it to be a fallacious species of evidence, that ought not to be admitted into inductive inquiries. But philosophical analogy is very different from rhetorical analogy. The first consists in any real resemblance between phenom-

ena, less than identity: but the last is a mere fanciful resemblance discovered by the imagination, and is properly used for mere illustration or ornament, and can never be made the foundation of inductive inference in philosophy. The want of this distinction has been a most fruitful source of error; for the history of philosophy shows that there is nothing more delusive than these fanciful analogies. Bacon has actually based what he calls Philosophia Prima, primitive or summary philosophy, upon these fanciful analogies: at least every example which he has cited in illustration of this department of philosophy, is based upon them. And what is still stranger, he makes this remark, in regard to the examples: "Neither are these only similitudes, as men of narrow observation may conceive them to be, but the same footsteps of nature, treading or printing upon several subjects or matters;" thus showing that he was aware that there was some such distinction as I have exhibited. And in the fifty-fifth aphorism of the first book of the Novum Organon, he has mentioned as a source of error, the tendency of some minds, to "compare even the most delicate and general resemblances;" and that such minds "readily fall into excess by catching at shadows of resemblance."

Some writers have confined analogy to the resemblance of relations, both in philosophy and rhetoric. But this is unphilosophical, and exceedingly inconsistent in practice, multiplying distinctions which cannot be kept up by even the greatest degree of caution. In philosophy every real resemblance less than identity, is analogy; and so in rhetoric, every fanciful resemblance is analogy. In rhetoric, however, the analogy is always between individuals of different species, and never between individuals of the same class.

For a full discussion of this subject and its kindred topics, I beg leave to refer to the second edition of my work on the Baconian Philosophy.

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ART. XXXIII.—*Remarks on the Observations of S. S. Haldeman "on the supposed identity of Atops trilineatus with Triarthrus Beckii;"** by JAMES HALL.

THE simple question of specific difference or identity between two forms of a fossil Trilobite, would not tempt me to a moment's discussion, were it not connected with other points of greater importance. The subject, indeed, was considered by the Association, at its meeting in New York in 1846, of sufficient interest to demand a committee to investigate it, and the report of that

* Proceedings of the Association of American Geologists and Naturalists, held at Boston, September, 1847; Am. Jour. of Science and Arts, this volume, p. 107.

committee appears in the proceedings for 1847. As truth is the object before us, we need offer no apology for presenting some points of the case which have not been discussed, bearing upon that report.

Were it even determined that these fossils from different localities, and from slates in different conditions, are different species, the question supposed to rest upon it, is not in our opinion at all decided; for if there be so close an analogy in the genera and species of Trilobites that there is an acknowledged difficulty in deciding upon the difference between them, then it must be confessed that there is still less reason for the foundation of a distinct system of fossiliferous deposits upon this basis.

In the summer of 1844, Dr. Fitch of Salem, Washington county, N. Y., discovered in the partially altered slates of Greenwich, in that county, some remains of Trilobites, which were placed in the possession of Dr. Emmons who subsequently visited the locality and obtained other specimens. These were published in his paper upon the Taconic System in the same year, and subsequently in his Report on the Agriculture of the state, in 1846.* These fossils were shown to me at the time of their discovery, and one of them decided to be new while the other was unquestionably the *Calymene* (*Triarthrus*) *Beckii*. The former was published under the name of *Elliptocephalus*,† and the latter of *Atops*.

In 1846, at the meeting of the Association in New York, I remarked, in a discussion upon the Taconic System, that the *Atops trilineatus* and *Triarthrus Beckii* were identical, and hence the reference to a committee.

It remains now to inquire of what importance are the differences pointed out, in the report of Mr. Haldeman, and whether these differences are actual and constant, or only accidental and dependent on circumstances.

The *Calymene* (*Triarthrus*) *Beckii*, was first named by Prof. Eaton, *Brongniartia carcinoidea*, from a buckler which he supposed to be the entire animal. Prof. Green followed, proposing the name of Triarthrus, still describing the imperfect buckler as the entire animal. Subsequently, Dr. Harlan, obtaining some of the articulations of the thorax, referred it to the genus Paradoxides. The latter name was followed by myself in the American Journal of Science, Vol. xxxiii, p. 137, where the true characters

* *Agriculture of New York:* comprising an account of the classification, composition and distribution of the Soils and Rocks, and the Natural Waters of the different Geological Formations, together with a condensed view of the climate and agricultural productions of the State. By Ebenezer Emmons, M.D. Vol i. Albany. 1846.

† This fossil is undoubtedly a species of Olenus, judging from the general character of an extremely flattened specimen. See Palæontology of New York, vol. i, p. 256, pl. 67, figs. 2*a*, *b*, *c*.

of the entire fossil were first shown, though an error was committed in describing two species, from forms now known to be dependent on the presence or absence of the maxillary portions of the buckler. This Trilobite appears upon further examination to be a Calymene, and the difficulty attending its determination has arisen partly from the separation of the marginal portions of the cephalic shield, at the suture, leaving the central part as the usual representative of its form. This part of the fossil also presents a considerable variety of form dependent on the nature and condition of the enclosing matrix. It occurs rarely in the Trenton limestone, but is abundant in the Utica slate, where the specimens are usually very much compressed and the parts separated. The crust is extremely thin and the surface markings, under a magnifier, are similar to those of Calymene senaria, except being smaller and the points sharper. The fine granulations or papillæ are well developed near the junction of the central and lateral lobes, the more exposed parts being (as in other trilobites) often smooth. A row of short spines or tubercles extend down the back on the central lobe giving a prominent and unmistakable character to the species.*

The form and proportion of parts are variable, depending upon the degree of pressure suffered, and the direction in which the force was applied. This condition is better illustrated by figures of actual specimens than by any description.

In the specimens, fig. 1 *a*, *b*, from the Trenton limestone, the proportions are nearly similar, the whole individual being convex, above, and probably presenting nearly its natural form and proportions. The cephalic shield is semi-elliptical rather than semi-circular, the width being much less than twice the length as stated by Prof. Haldeman. The medial lobe of the thorax is widest at the base of the buckler not in the lower part, where the proportions are reversed. The lateral segments are impressed with a distinct groove which becomes wider towards the extremities.

In fig. 1*a*, the lateral portions of the cephalic shield are separated. In fig. 1*b*, these parts are partially preserved.

The specimen, fig. 2*a*, is a nearly entire individual from the Utica slate, much compressed. The buckler is imperfect in the absence of the maxillary shields, and is nearly twice as wide as long; the proportions of the middle and lateral lobes of the tho-

* For the character and affinities of this fossil, see Palæontology of New York, vol. i, pp. 237, 250, 251, and 252, with references to plates and figures of the same work.

rax and abdomen are varying with the distance from the buckler. The outer crust of this specimen is removed and the small spines on the back are nearly obliterated.

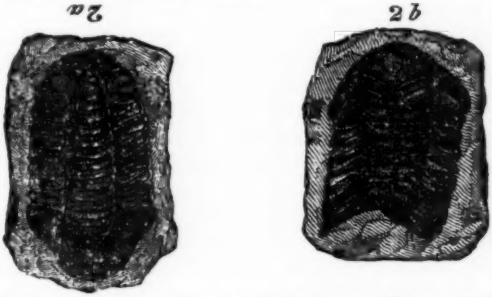


Fig. 2*b* is a specimen preserving the maxillary shields of the buckler, which are partially displaced and compressed. Buckler scarcely twice as wide as long.

Fig. 2*c* is a fragment of the thorax and caudal extremity very perfectly preserved, and presenting the usual proportions of this part of the animal when not distorted.

Figs. 2*d*, 2*e*, are two specimens of the buckler, the one preserving the maxillary portions while they are wanting in the other. The proportions of length and breadth are slightly different, but neither of them twice as wide as long.

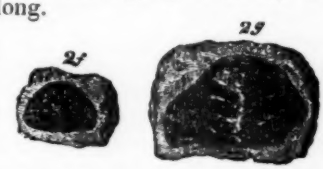


Fig. 2*g* is the imperfect buckler of a specimen more than usually convex in the middle and having the lobes more distinctly marked. Fig. 2*f* is a buckler having a width scarcely once and a half the length. This is an example of the specimens described by Prof. Eaton and Prof. Green.* It is very convex and apparently contracted or bent downwards at the margins, other more convex specimens are of common occurrence. The proportions between the lateral and middle lobes of the buckler, it will be

* See Eaton's Geological Text-book, vol. i, fig. 2, and Green's Monograph plate, fig. 6.

observed, are even more variable than the proportions of length and breadth, and neither can be relied upon in the absence of other characters. The characteristics of Triarthrus as given by Prof. Haldeman are doubtless the faithful *portrait of an individual*, but do not characterize the species. As well might we expect a cylinder to present the same form and proportions to the eye as it becomes flattened or spread out, as that any body having the form and characters of a trilobite, should retain them under all conditions and circumstances of compression and lamination which have befallen the strata in which it is imbedded.

In one of the specimens of the so-called Atops, and in the one which Prof. H. examined, the body is partially folded and the front of the buckler bent downwards, giving it a less apparent proportional length, and from the same cause the middle lobe is more convex, while subsequent pressure has extended the whole in its lateral dimensions. In another specimen of this fossil, the proportions of the parts of the buckler vary materially from those given in the description.* The body is said to be distinguished by having the lobes equal in width, while the specimens figured (as just cited) show an equal variation with those of the Triarthrus from the Utica slate.

There is another very distinctive character in this fossil which appears to have escaped the observations of, or if observed is not mentioned by, Dr. Emmons or Prof. Haldeman, and this is, that the middle lobe of the thorax is marked by a row of small spines or tubercles which are distinct in the specimens, but more particularly in the moulds or impressions made by the crust which is nearly or quite destroyed. These spines have exactly the character of those in the Triarthrus, while the papillose or granulated surface in the two fossils is precisely similar. It should be remembered that the specimens to which the name of Atops has been applied, are found in shales which are not only thinly laminated but extremely contorted or folded and partially altered in lithological character, so that we should expect distorted forms and proportions in fossils since we know that this always happens under such circumstances.

If we compare the characters given by Prof. Haldeman and apply the modifications shown to be necessary by the examination of a large number of specimens, we may have:—

(*Triarthrus*) *Calymene*:—Cephalic shield semi-elliptical or semi-circular, breadth varying from one and a half to twice the length, *medial lobe* widest, *lateral lobes* variable in width, which is due to different degrees of convexity, the extremities being bent downwards or expanded. In the "*abdomen*" or *thorax*, the proportion of the lobes is variable at different distances from the

* See Palæontology of New York, vol. i, plate 67, figs. 4 *a*, *b*, *c*, *d* and *e*.

buckler; surface finely papillose with a row of short spines down the back.

In Atops we have essentially the foregoing characters, the difference in the form of buckler which occurs in a single specimen being due to a very apparent cause, which likewise produces the different proportions of lateral and central lobes. The proportion, form, and every other character of the lobes of the ("abdomen") thorax and caudal shield are precisely similar.

To those who are in the practice of examining fossils imbedded in stone, these differences of form and proportions are readily understood, and to those who may rely upon such characters for specific distribution, we can only say that following such a rule, the number of fossil species can easily be quadrupled in a short time without the necessity of further investigations.

The determination of a species and of its importance particularly in connection with geological questions, is a matter of some consequence, and we must protest against such a course as will place paramount to every other decision, the determination of two supposed species of distinct genera, by authority, however competent, from the examination of a single imperfect specimen of each, imbedded in a material of different character, and with reference to no other characters than difference of form and proportions of parts of the individuals.

The reasons for referring the genus *Triarthrus* to *Calymene* are mainly founded on the structure of the cephalic shield, the maxillary portions of which are shown in fig. 2*i*, where it will be seen that the facial suture terminates at the posterior angle of the buckler, leaving a portion of the base of the eye upon the maxillary shields. The labrum or epistoma shown in connexion, is that of a true Calymene, and though I have never found it attached to the fossil, it occurs with the other fragments in such positions as to leave little doubt of its relations. In the Olenus, the body of which resembles the Triarthrus, the facial suture terminates at the basal margin of the cephalic shield distant from the angles. The direction of the suture in front of the glabella and the form of the eyes are also quite different from the *Triarthrus* or *Calymene*.

2*i*

ART. XXXIV.—*Second Letter on Philosophical Analogy;* by JAMES D. WHELPLEY. (Addressed to one of the Editors of this Journal.)

* * * In my last letter,* I attempted to express what seemed to me the true distinction between the hypothetical and the truly scientific method of reasoning. This method was named, for convenience, "Induction by Analogy," or, Analogical Induction,—a method of reasoning from the known to the *unknown* in nature.

It is usual with men of science to say, that no theory can be admitted as true until it has been fully tested by experience; and yet it is quite certain that no experience will ever make us acquainted with the arcana of nature—we can never *see* a pulse of light, or *feel* a particle of matter. The senses give but a superficial acquaintance with things;—and it is only by profound speculations that we arrive at a knowledge of powers, forms, and substances. But it is surely no method of arriving at a knowledge of things, to begin by supposing that we already have that knowledge,—to begin, for example, while we are studying the nature of gold molecules, by imagining a gold molecule, and then attempting to test our imagination by the facts. This procedure is extremely tedious, to say the least; one might go on imagining all kinds of gold molecules, to the end of time, and expend an infinite quantity of calculation in testing each imagination, without ever finding the true one. And if we ask ourselves what it is that we are seeking, it will, perhaps, occur to us that we know nothing about the matter—that we are in fact seeking after nothing, but only trying chances with fortune.

The substance, gold, has certain chemical, mechanical, electrical, and thermal, qualities, which occasion all its sensible properties and appearances: our object is to unite all the substantial forms and qualities suggested by these in the idea of an invisible *atom* of gold; just as by experience, we unite all its visible and tangible properties, in the notion of a visible mass, or particle, of gold.

In a similar manner, when we are familiar with all the external properties of a man, and have a perfect observation of him, as a moving object,—when all his features, forces, and habits, are sensibly impressed upon us,—we conceive of him not as a mere aggregate of these, but as an individual, a *unity*, so composed, of invisible, and spiritual, qualities, concentered, blended, and co-

* See Letter on Philosophical Induction. American Journal of Science for Jan. 1848, p. 33.

operative, as to be the simple and undivided source, and cause, of all the appearances that invest, and define him.

Of the visible mass of gold, we must have a perfect observation; we must have a natural-historical, and a dynamical, knowledge of it, in all its relations and conditions, before the idea of its intrinsic and undivided unity in an atom, can arise in our minds.

Now, just as far as our spiritual idea of a man is in conformity with, and arises out of, our sensuous knowledge of him, so far that spiritual idea is a true and practical one, and will not deceive us; we may act upon it, and be guided by it, in all our conduct; trusting in that perfect harmony which exists between the idea and the object. And as far as the chemist knows dynamically and formally, the qualities and properties of gold, so far he is enabled to form such a theory of the atom of gold, as will guide him aright in all operations, or speculation, upon it. As in the knowledge of men, so in chemistry and physiology, experience precedes theory, and theory guides conduct; and he whose theory is most perfect, is removed farthest beyond chances and accidents. And as in the conduct of life, whoever proceeds upon hypothetical notions of men and their ways, will live a sad life if he lives long, so, our unfortunate savan, who has directed his reason upon the substances that compose the earth, as well as upon the men who walk upon its surface, finds himself playing at blindman's buff with nature, and strikes continually against pointed facts, and falls into deep absurdities.

Observation being directed either upon *things* and their *forms*, or upon *events* and their *order*,—both of which are necessary to the complete observation of an individual,—there arise two departments of natural history: the *formal* merely; as in the classifications of Linnæus—where form, alone, is admitted as affording specific marks—and the *dynamical*, or of the order and times of changes; as in that part of natural history which treats of the motions of falling bodies, the changes of the atmosphere, or of habits of animals.

The history of any substance, or of any living species, cannot be regarded as complete, until a full and perfect observation has been made and verified, not only of its form, but of all its changes and specific motions. The long nails of the sloth are its most obvious specific mark, but a specific knowledge of the sloth embraces also a knowledge of the functions of these long claws, and of the habit of suspending itself by them, and climbing by them, beneath the branches of trees.

The force with which a mass of gold will fall toward the earth, is as necessary to a specific knowledge of it, as its color, or the angles of its crystals.

Observation, however, is not satisfied with a merely external knowledge of things and their changes: we wish to know, not

only the habits of an animal, but the physiological conditions of those habits—not only the changes of a metal, but the chemical conditions of those changes. We wish to have an idea of the animal life, and of the substances of things.

To limit these remarks more accurately,—let us premise, that our sensuous knowledge of *in*organic nature is acquired through *four* departments of observation; *to wit*,

1. Of the masses of matter, in all their conditions, whether of solid, liquid or aëriform, amorphous or crystalline, dense or rare. This includes all that can be said of inorganic substances considered as permanently existing, under the conditions in which they are observed.

2. Of changes happening in all forms, and masses, of unorganized matter. This regards changes of temperature, and all mechanical changes, elastic, of expansion, contraction, &c., referred always to matter as it lies in mass, with no reference to its internal, or atomic, form.

3. Of the internal *condition* of matter, or rather of those properties which give rise to a theory of its internal condition. These include all observations with reagents, in the laboratory. *Chemistry.*

4. Of the internal *motions* of matter, electric, gravitant, magnetic, photogenic, and thermogenic, (light-producing and heat-producing.) These give rise to theories of decomposition and recomposition, and of *atomic* motions in general:—*dynamical and statical chemistry.*

Under these four grand heads of observation, every part, or form, of the material universe may be ranked in its place.

Observation, if *correct*, is always *scientific*, of course. For, no one is disposed to regard Linnæus as less scientific than Faraday, because the Swede confined himself to the first, and the Englishman to the last, of these four departments of observation. Indeed, was it not necessary in the nature of things, that Linnæus should begin where he did, with arranging all things according to their forms, in order that Cuvier, Owen, De Candolle, Lavoisier, Davy and others, should find the field prepared for them. The philosopher who never passes the limits of truth and necessity, is well content that his predecessor should have prepared the way for him. He regards his predecessors with the same respect that he claims from his successors.

In the present condition of our nomenclature, it is very difficult to classify the departments of science correctly. The great departments are each of them vast collections of facts, upon which every kind of observation has been brought to bear. And that this should be so, is neither to be regretted nor avoided. The whole purpose of science, being to form a true and perfect idea

of the universe; material, organic, and spiritual; such as may satisfy the aspiration of Reason to understand the wisdom of the Creator in his work. Each department aims to perfect some one cosmical idea; as, in geology, of the order of the creation; in meteorology, of the system of the atmosphere and its changes; in astronomy, of the movements of the isolated spheres of matter, in free space; in zoology, of the system of living animals; in anthropology, of the natural history and distribution of the human race.

In each department of cosmology, a knowledge of all the methods of observation is required; nor are these less necessary to be known to those who give their chief attention to the science of the human mind itself, which, as the crowning work, includes and presupposes all the others.

Of Inductive Science, the divisions, in all of which the four forms of observation are employed, are at least three in number, *to wit*,

1. The science of material, inorganic, nature, of which the four divisions have been given.

2. Organology, the science of organized bodies, divided into,

(*a.*) The study of the forms,—as by the method of Linnæus.

(*b.*) The study of the changes and motions,—or of Natural History proper.

(*c.*) The study of organized substances, in their interior constitution.

(*d.*) The study of the secret powers of life, (analogous with electricity and magnetism.)

3. Psychology, the sciences of Instinct, Passion, Intelligence, and the Rational Energies.

(*a.*) In the forms, or species, inspired by Instinct, Intelligence, &c.

(*b.*) In the habits and motions, prompted by Instinct, Intelligence, &c.

(*c.*) In the peculiar specific Energies of the same,—as of love, fear, appetite, aversion, &c.

(*d.*) In the play of these Energies, the direction and combination of them, in the Instinctive and Intelligent life of the animated being.

I have endeavored to present these divisions with some degree of accuracy, in order to illustrate in a more complete and satisfactory manner, the method of induction which it is my desire in this letter to establish, not only as the best, but also as the only practical and available method, for the advancement of science. For it can be shown, that in each of the four departments of observation, in the three great sciences of Psychology, Organology and Hylology, (i. e., of the spirit, the organism, and the matter,) the same method of reasoning holds good through-

out, and may be employed as well in the detection of a law of instinct, or a power of intellect, as in the discovery of a new metal, or of a new physiological law; and that, too, by a process, not of invention or imagination, but of plain deduction from facts.

Starting from the highest, and at the same time the most universal act of the Inductive Reason, let us consider first, by what mental operation we arrive at that knowledge of human nature, and confidence in each other, which makes the common intercourse of society easy and agreeable?

From infancy upward, we are taught to observe with an intense acuteness and solicitude, the actions, gestures, and conversation, of those with whom we associate. By an effort of reason, as unconscious as it is profound and scientific, we refer all human actions and gestures to certain spiritual principles, which we conceive to have their seat *within* the person. We are conscious of such principles in our own nature, and of the gestures and conduct which spring from, which express, and which gratify these energies of the soul. In all languages, whether of barbarous or of cultivated nations, certain words and signs stand for them, and the refinements of oratory and poetry consist entirely in their nicer and more powerful expression. What, for example, more marked and observable than the language, features and conduct, proper to a headstrong obstinacy of Will?

Conscious of impulses of will in ourselves, and knowing the conduct proper to it, we are at no loss to detect it in another; and having observed it in a great number, we at length conceive of will, as of an energy—the fundamental energy—of the human soul.

The *first* step of this observation regards only the form of humanity, of the human person; and to this we attach a specific idea.

The *second* step is to observe the motions and changes of the person,—and to these also, we attach to the same idea.

By the *third* step we conceive of a latent individuality, or unity of powers, in the person observed;—

And the *fourth* step brings us to an observation of the modes and directions, in which this individual Power, or Energy, operates, and excites itself.

When the circle of observation is complete, we have attained a true and scientific knowledge of the human Will, as a free, specific and individual, power. Persons gifted with a powerful faculty of moral observation, see unconsciously through every trait of a character, with accuracy and rapidity, and, from the observation of an hour, take a true impression of the whole; but this power is given to but few, and is developed only by great experience and thought. In this field, scientific reason works so rap-

idly and naturally, being engaged, so to speak, in the very duty appointed her, she is seldom surprised at her own discoveries, and goes through the most profound studies of character, under the ordinary stimulus of fear, ambition, or private necessity.

The processes of such studies, are those of Analogical Induction, as will appear from the mere statement of them in detail. For, first, we feel a passion or emotion in ourselves, and know the actions that flow from it; and then, observing the same actions in another person, we conclude them to flow from a similar passion, or emotion, in that person; reasoning from the known effects to the unknown cause,—from the known action, to the unknown energy which is the source of those actions.

In the *second* great field of science, that of organization, the same order of observation prevails as in psychology. Let an example be taken from botany.

The first thing that enters the mind on observing several individuals of a particular vegetable, is a specific resemblance in them all: we look upon their *forms* and call them all together by one name, as *the* oak, *the* elm, *the* rose. As expression is the mark of spirit, organic *form*,—difference of parts with unity of figure,—is the mark of organization.

From the form, we pass to observing the motions of the plant, or if it have no motions, to its position in regard to surrounding objects.

By a third effort of attention, we notice its substance, and the character of the tissues which compose it.

By a fourth step we notice the growth, and the textural, internal motions and changes, of its substance.

Our observations being thus completed we have a full and scientific knowledge of the species. Our deductions in this, as in the former instance, were from the known to the unknown, and by analogy,—

1. From the known, divisible, figure of several particulars, to the unknown, indivisible *form* of the species, in general.

2. From the observed motions of the plant, to its internal qualities, in regard to motion; as of elasticity, expansion and contraction, &c.

3. From the observed color, texture, weight, to the substances or real constitution, of the plant.

4. From its habits, as of feeding, moisture, growth, &c., to the vital forces which cause its development.

The analogical operation of the mind in this species of reasoning upon natural objects, is that by which it regards the image which it forms to itself, to be the real counterpart and representative of an unknown somewhat in the plant, which is the secret and invisible cause of all its external properties and chan-

ges. This invisible somewhat we call the species or image; as if it were the same thing with the image or species in the mind.

In making this use of the word Analogy, I have not adhered to its logical acceptation. In logic, analogy is the inferring of a whole from a part, and *v. v.*; as when, observing a certain bird to have some of the external habits of a thrush I infer it to be a thrush.

*Syllogisms* by analogy are necessarily imperfect. Thus, if species A is in some particulars like B;—I infer by analogy that it is the same with B, which is inconclusive. Observing that the material universe is governed by certain laws, I infer that the spiritual universe is governed by similar laws; which is inconclusive. Observing that one man under certain circumstances will act so and so, I infer that another man under similar circumstances will act in the same manner. The evidence is never complete.

The *certainties* of logical analogy are, that like causes will produce like effects; that like properties belong to like substances; and finally, that a concurrence, or working together, of events, indicates that they must be referred to a common principle, or substratum.

The certainties, on the contrary, of the analogies of mere resemblance are, that two similar appearances or properties are identical, as the yellow of one metal with the yellow of another; which we name *similarity*, where the thing is different but the appearance the same: as when two different metals have the same color. Secondly, when there is an apparent difference, but a real similarity; as when the same object in different lights has different colors. And, lastly, when species of different genera, have a certain similarity of appearance, as in the apparent resemblance of the vulture to the tiger, or the hog to the aquatic birds, through the grossness of the body and habits of both.

To give these two kinds of analogy in detail.

1. *Analogies of logic, or of Judgment.*
   - (*a.*) The same properties indicate the same substance or essence.
   - (*b.*) The same causes have the same effects.
   - (*c.*) Concurrent events have a common principle.

2. *Analogies of Classification; or of Memory.*
   - (*a.*) The same appearance indicates the same species.
   - (*b.*) The same object at different times may present different appearances.
   - (*c.*) Objects intrinsically different may resemble each other.

3. The analogies of logic, and those of classification, are well understood and employed, in the scientific use of the judgment and the memory. But neither of these are to be confounded with that third kind, which it is the object of this letter to define and explain; I mean Philosophical Analogy, which creates THEORIES. Scientific theory relates either to numbers, forms and orders, or to the determination of powers, causes and principles. The theory of a natural system of species and genera, is a theory of number, form, and order: the theories of chemistry and physiology, on the other hand, regard only substances, powers, and principles. But a complete knowledge of nature cannot be attained through either of these, alone: ideas must be conceived which embrace both;—ideas, for example, of the simple elementary substances of chemistry, which enable us to classify them in a system that harmonizes not only their forms, and numbers, but shows, also, their chemical and dynamical relations.

To effect this we make use of that superior kind of analogy which has been named the philosophical; distinguished from the two others, while it subordinates and reconciles them.

Of philosophical analogy, itself only can be its definition; we may show what it does, but we cannot tell what it is. We cannot shape a theory of that power by whose aid we theorize.

THEORY, from θεωρεω, to discern—figuratively, to see through or understand—is, in its philosophical sense, a fruit of analogy; the attaining of the idea of a principle common to, and actuating, many things. Thus, my theory of humanity, founded upon an infinite number of comparisons in my thought, of all human forms and actions among themselves, is a theory of the human soul, with all its attributes, coëxistent in an immortal, absolute, unity—the indivisible spirit of man. My philosophical theory of gold, is of an indestructible somewhat having invariable powers, divided into individual atoms, and giving rise to certain phenomena.

Cosmical theories, are for the most part, merely scientific, as that of heat, or of gravitation; or they are methodic or systematic, as the natural system of plants; but these are readily distinguished from philosophical theories which relate to the first principles, or unities, of existence. It cannot be denied that the philosophical faculty is present, and presides, at the formation of every theory, whether in classification, as in defining a genus of animals; or in the scientific use of judgment, as in the idea of gravitation; for in all such operations of the mind, there is an effort toward unity; but we have now to separate the kinds.

3. *Analogies of the Philosophical or Unifying, faculty.*
   - (*a.*) In classification: as for example, in the morphology of plants, and animals, where all the parts are deduced from the germ.
   - (*b.*) In the scientific use of judgment; as, when electricity, heat, gravitation, &c., are referred to a common principle.
   - (*c.*) In pure philosophizing; as in attaining the idea of soul, substance, life.

In the foregoing analysis I have endeavored to exhaust the subject of analogy in its scientific application, by considering every operation of the scientific intelligence in which it would come in play. If it is not displeasing to you, I will endeavor in my next, to make some practical applications of it in the theory of temperature.

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ART. XXXV.—*Two new Minerals,—Medjidite (Sulphate of Uranium and Lime)—Liebigite (Carbonate of Uranium and Lime)*; by J. LAWRENCE SMITH of South Carolina, Geologist to the Sultan of Turkey.

THE minerals here alluded to were found associated with a specimen of pitchblende from the neighborhood of Adrianople, Turkey; it was quite impure and a portion of it contained crystals of copper pyrites. On the surface of the pitchblende, besides the two minerals in question, there existed crystals of sulphate of lime and a little oxyd of iron.

MEDJIDITE—*Sulphate of Uranium and Lime.*—This mineral is of a dark amber color, transparent, of imperfect crystalline structure, fracture vitreous, although the surfaces exposed are sometimes of a dull yellow color, arising from the loss of water. It is found on the surface of the pitchblende associated in some places with crystals of sulphate of lime. Hardness about 2·5 —sp. grav. not known.

*Chemical characters.*—Heated gently it loses its water, becoming of a lemon yellow color. Heated to redness it blackens (being converted into oxyd of uranium and sulphate of lime). It is insoluble in water, but dissolves readily in the smallest quantity of dilute hydrochloric acid; (in this way had it been necessary I might have separated it from any adhering sulphate of lime.) The acid solution gives a tolerably abundant precipitate with hydrochlorate of baryta, and a red brown precipitate with ferrocyanuret of potassium; bicarbonate of ammonia forms a precipitate that is redissolved by an excess of the ammoniacal salt; oxalate

of ammonia added to this solution demonstrates the presence of lime. Farther examination detected no other substance.

So far as the small quantity at my disposal enabled me to make out its composition, it would appear to be a salt similar to the following one (Liebigite) with less water, and sulphuric instead of carbonic acid, the acid being derived from the decomposition of the pyrites associated with the pitchblende. Its composition is represented by $\ddot{\mathrm{U}}\ddot{\mathrm{S}}+\dot{\mathrm{C}}\mathrm{a}\dot{\mathrm{C}}+15\dot{\mathrm{H}}$.

This mineral is called *Medjidite* in honor of the reigning Sultan of Turkey, Abdul-Medjid, who exhibits a most decided patronage of both the arts and sciences, certainly much more than any of his predecessors.

Liebigite—*Carbonate of Uranium and Lime.*—This mineral is not found crystallized, but occurs in the form of a mammillary concretion, having an apparent cleavage in one direction. It is of a beautiful apple-green color, transparent, with a vitreous fracture. Hardness between 2 and 2·5; sp. grav. not ascertained.

*Chemical characters.*—The mineral admits of ready separation from the pitchblende, and owing to its color and transparency is easily freed from the smallest portion of foreign matter. Heated gently, it loses water, acquiring a yellowish grey color; heated to redness it blackens without fusing, and on cooling returns to an orange red color; heated strongly before the blowpipe, with or without charcoal, it blackens and on cooling remains so; with borax it gives a yellow glass in the oxydizing and a green glass in the inner flame. Its property of blackening when heated to redness, and assuming an orange red color on cooling, made me suppose that it might contain vanadic acid, but as will be seen a little farther on, its reactions proved this not to be the case; as yet I believe that this property is not known to belong to any other natural combination of uranium.

The mineral dissolves readily in dilute acids and with violent effervescence, affording a yellow solution, that gives a yellow precipitate with ammonia and its carbonate, but the latter in excess, redissolves most of the precipitate, and what remains is found to be carbonate of lime. The carbonate of ammonia solution when boiled redeposits a yellow precipitate. In a neutral solution, sulphuretted hydrogen produces no precipitate, but the hydrosulphate of ammonia furnishes one of a brown color, and the ferrocyanuret of potassium one that is reddish brown.

The above properties show the presence of water, carbonic acid, lime and uranium, farther examination gave no evidence of the presence of any other substance.

The amount of this mineral in a state of purity was too small to allow me to make as minute a quantitative analysis as I should desire, but owing to the simplicity of its composition, the

true nature has been very nearly if not exactly made out. The water was estimated by heating it to 400° Fah.—the carbonic acid by what was lost in dissolving it in hydrochloric acid in a small apparatus properly arranged; to the acid solution bicarbonate of ammonia was added, which redissolved all the precipitate first found; oxalate of ammonia, when added to this, precipitated the lime, (which was afterwards estimated as a sulphate); the solution filtered from this precipitate, was boiled and the uranium deposited itself as a double salt that was heated to redness and the oxyd estimated in the form of olive colored oxyd. (Peligot's atomic weight for uranium was the one employed, 750—ox. 100).

The mean of two analyses, one of 85 and the other of 65 milligrammes, is

| | | Atoms. | Calculated. |
|---|---|---|---|
| Water, . . | 45·2 | 20 | 45·5 |
| Carbonic acid, . | 10·2 | 2 | 11·1 |
| Lime, . . | 8·0 | 1 | 7·1 |
| Peroxyd of uranium, | 38·0 | 1 | 36·3 |
| | 101·4 | | 100·0 |

The composition of the mineral is represented by

$$\ddot{\mathbf{U}}\ddot{\mathbf{C}} + \dot{\mathrm{Ca}}\ddot{\mathrm{C}} + 20\,\dot{\mathbf{H}}.$$

The pitchblende upon which the Liebigite is found was analyzed, and at some future time I may have occasion to allude to this analysis with some remarks upon the salts of uranium; for the present, suffice it to state, that the pitchblende contains lime associated with the oxyd of uranium, a circumstance that along with the tendency of oxyd of uranium to form double salts, accounts for the formation of both the Liebigite and Medjidite.

I have thought proper to give this double carbonate the name of the distinguished chemist of Giessen, as a demonstration of the high value I set upon his memoirs and important contributions to the science of chemistry in general.

Constantinople, January 1st, 1848.

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ART. XXXVI.—*Analysis of the Meteoric Iron that fell near Braunau in Bohemia, on the 14th of July*, 1847; by A. DUFLOS and N. W. FISCHER.*

1. *Treatment with Nitric Acid.*—5·16 grammes of the meteoric mass, removed by a hard file from the entire block, were put into a matrass to which was adapted a suitable delivery-tube terminating beneath the surface of water, and were submitted to

* Translated from Poggendorff's Annalen, vol. lxxii, p. 475, by W. G. LETTSON, Esq.

the action of pure nitric acid in excess until completely dissolved, and the fluid thus obtained was evaporated to dryness at a gentle heat.

The water in the receiver gave indications of *chlorine*.

The residue in the matrass was submitted repeatedly to the action of caustic ammonia and then filtered, the liquor thus obtained was of a bluish tint; it was acidulated with nitric acid and then tested with a solution of nitrate of silver and nitrate of baryta.

The first of these reagents indicated *chlorine*, the second sulphuric acid, and consequently *sulphur*.

After the excess of silver had been removed by hydrochloric acid and that of baryta by diluted sulphuric acid, the filtered liquor was again rendered alkaline by caustic ammonia, and a stream of sulphureted hydrogen was passed through it. The black precipitate caused thereby was put on a filter and the liquor passing through was again acidulated with nitric acid. It was now concentrated by evaporation, and in the first place caustic ammonia, and subsequently oxalate of ammonia, were added thereto.

A white cloudiness was produced thereby, which did not disappear upon the addition of acetic acid, indicating, therefore, lime and consequently *calcium*.

The fluid filtered from the oxalate of lime had phosphate of ammonia added to it.

After a considerable interval a crystalline precipitate was formed, indicating the presence of magnesia, and consequently *magnesium*. The portion of the nitric solution evaporated to dryness, which was insoluble in ammonia (oxyd of iron), was treated with hydrochloric acid, which dissolved it entirely with the exception of a few white flaky particles.

This extremely minute residue was silica, indicating therefore *silicon*.

Carbonate of baryta was added to the hydrochloric solution and digested therewith without the application of heat. After standing twenty-four hours the oxyd of iron thrown down was removed by filtration, the baryta contained in the liquor passing through precipitated by sulphuric acid, and the liquor filtered again, upon which an excess of caustic ammonia was added thereto and a current of sulphureted hydrogen passed through it. A black precipitate was produced thereby, and this was collected upon the same filter upon which the first similar precipitate already was lying, whereupon the whole was carefully washed with an aqueous solution of sulphureted hydrogen. This precipitate was dissolved in nitric acid and a solution of caustic potash added thereto.

This produced an apple-green precipitate. Hydrate of the oxyd of nickel, indicating *nickel*, therefore, to be present. This

hydrate of the oxyd of nickel when edulcorated, dried and exposed to a red heat, amounted in the whole quantity of material operated on, (5·16 grammes,) to 0·364. Since upon its re-solution in hydrochloric acid, chlorine was disengaged, and also a yellow precipitate formed upon the addition of nitrite of potash to that solution, the oxyd of nickel contained cobalt.

It was therefore again dissolved in hydrochloric acid and nitrite of potash in excess added to the solution, the precipitate formed thereby—a double-salt consisting of nitrite of potash and oxyd of cobalt—removed by filtration, and the liquor passing through mixed with caustic potash, upon which a precipitate was formed, the weight of which, when dried and exposed to a red heat, was 0·329 gramme,* equal to 0·2589 *nickel*. From the yellow cobaltic precipitate was obtained 0·0348 gramme oxyd of cobalt, corresponding to 0·0273 *cobalt*.

2. *Treatment with hydrochloric Acid.*—2 grammes were digested with an excess of moderately diluted hydrochloric acid without the application of heat until no further action was observed. There remained but a few black flocculent particles which, by pouring off the solution with precaution, were ultimately placed upon a piece of platinum foil, where they were well dried and then made red-hot. Upon the foil becoming red, a transient glimmer was noticed, indicative of *carbon*, while an extremely inconsiderable grey residue (*silica*) was left upon the foil.

The hydrochloric solution was impregnated with sulphureted hydrogen and allowed to stand, loosely covered, in a warm place for twenty-four hours. By this time an insignificant quantity of a dirty brownish white precipitate had collected on the bottom of the vessel. The clear supernatant fluid was poured off, the precipitate collected upon a filter and well washed with a solution of sulphureted hydrogen slightly acidulated with hydrochloric acid, and finally treated upon the filter itself with sulph-hydrate of ammonia, whereby it became dissolved with the exception of a

* Upon our recognizing the presence of cobalt by the disengagement of chlorine upon the solution in hydrochloric acid, and being about to proceed to the separation thereof from the nickel, a remark occurred to me that I had made as long ago as 1830, to the effect that nitrite of potash precipitates cobalt from a solution in the form of a yellow insoluble powder—a double-salt. And as I now found upon looking more into the matter that this reaction of the nitrite of potash is well adapted to the separation of cobalt from nickel, we had recourse to the process in this inquiry. The method recommends itself by its simplicity and the ease with which it may be applied, inasmuch as it simply consists in adding to the nitric or hydrochloric solution of both metals, a saturated solution of nitrite of potash in excess, whereby either immediately or after some time—according to the concentration of the solutions—the greater part of the cobalt is thrown down. To remove completely every trace thereof, the fluid is to be evaporated to dryness at a gentle heat and the residue to be dissolved in water to which some ammonia has been added. The cobalt then remains undissolved in the form of a yellow powder. With regard to the details of this separation, the nature of this double-salt, and indeed the nitrous salts altogether, see a future paper. F.

slight blackish-brown residue. This latter had poured into it, upon the same filter, a portion of moderately diluted warm nitric acid, and this nitric fluid was evaporated in a watch-glass at a moderate temperature, upon which caustic ammonia was poured upon the residue, and a drop of a solution of prussiate of potash added thereto, upon which the whole was set aside. After the lapse of some hours a distinctly recognizable deposition of the cyanuret of copper and iron was to be observed, indicating therefore the presence of *copper*.*

The sulphureted ammoniacal fluid was evaporated to dryness, whereupon the residue was mixed with soda, and a portion of this mixture exposed to the action of the blowpipe upon charcoal. An unmistakable garlic odor was given off, indicating therefore the presence of *arsenic*.

In order to determine quantitatively the amount of iron, a portion of the solution of the protoxyd of iron corresponding to 0·217 gramme of the substance was oxydized with nitric acid, very considerably diluted and then added, drop by drop, to a boiling ammoniacal fluid in excess. The hydrous oxyd of iron was collected, well washed, dried, and exposed to a red heat. Its weight was 0·285 gramme. This gives for 5·16 grammes of the meteoric iron 6·773 of oxyd = 4·7411 metallic iron. A second similar portion of the solution of the protoxyd of iron was oxydized, neutralized with ammonia and precipitated with succinate of ammonia. The precipitate when collected, washed and heated as before, weighed 0·285 gramme, the very amount obtained in the former experiment.

3. *Treatment with Alkalies.*—1 gramme of the filings was mixed with five times its weight of a mixture of equal parts of pure nitrate of potash and carbonate of soda, and maintained for some time at a state of igneous fusion in a silver crucible. The mass when cold was treated with boiling water, the liquor thus obtained was filtered, and the fluid passing through supersaturated with dilute sulphuric acid, upon which it became of a yellow color. Sulphurous acid did not cause any green color therein. It was supersaturated with ammonia which produced no cloudiness; sulphureted hydrogen was next passed through it and the mixture put aside to stand in a close vessel. After the lapse of some days a few brownish flocculent particles had settled down to the bottom.

* Of all tests for copper I look upon ferrocyanuret of potassium, when used as here described, as the most sensitive and the most certain, inasmuch as by its use the slighest traces are indicated in a solution of the most various metallic salts. Caustic ammonia is to be added to the solution in which a trace of copper is suspected, and there is further to be added thereto a small quantity of a solution of the ferrocyanuret of potassium. Immediately there is, of course, no reaction to be observed; but gradually, as the ammonia evaporates from the open vessel, a reddish tint may be noticed in the fluid, and subsequently there will be observed a deposition of the cyanuret of copper and iron upon the sides of the vessel. F.

The fluid was poured off from them in part, the remainder being removed by filtration. This residue was then dissolved in a few drops of nitric acid, the solution evaporated to dryness with a small quantity of soda and heated before the blowpipe upon a platinum wire. A bluish green color was developed, indicative of the presence of *manganese*.

The transparent filtered fluid was again supersaturated with sulphuric acid, evaporated to half its volume and then filtered; this liquor was then tested with the ammoniacal solution of a magnesian salt for phosphoric acid, but even after a lapse of a considerable time no precipitate was observable.

From the above it appears that the Braunau meteoric iron, both in a qualitative and quantitative point of view, bears a very close resemblance to that of Bohumiliz. Its constituents are, as deduced from the foregoing experiments, in the hundred parts, as follows:

| | |
|---|---|
| Iron, | 91·882 |
| Nickel, | 5·517 |
| Cobalt, | 0·529 |
| Copper, Manganese, Arsenic, Calcium, Magnesium, Silicon, Carbon, Chlorine, Sulphur, | 2·072 |
| | 100·000 |

Since the completion of this analysis, the remarkable fact has been established that the Braunau meteoric iron is not homogeneous throughout, but that it contains nodules of *iron pyrites* (in which Professor Fischer—according to the "Schlesische Zeitung," of the 14th of October—has detected charcoal, phosphorus and chromium.) We are in the first instance indebted for this fact to that liberal Prelate, Dr. Rotter, Abbot of the Benedictine Monastery at Braunau, who generously permitted portions to be sawed off from the mass that fell at Hauptmansdorf for various institutions at Breslau, for Baron Humboldt, and for the public collection of minerals at Berlin.

This latter specimen, one of very considerable size, contains one of these nodules. (P.)

[The occurrence of both white and yellow iron pyrites in the American meteoric irons, has been repeatedly mentioned in this Journal both by myself and by Prof. Shepard. The mode of occurrence of these nodules, is clearly shown in the fac simile copy of the etched surface of the Lockport iron, in this Journal, vol. xliii, p. 390.—B. S., Jr.]

ART. XXXVII.—*Objections to the Theories severally of Franklin, Dufay and Ampère, with an Effort to Explain Electrical Phenomena by Statical or Undulatory Polarization;* by ROBERT HARE, M.D., Emeritus Professor of Chemistry in the University of Pennsylvania.—Continued from p. 236.

*Supposed grounds for a Theory.*

28. The grounds upon which I venture to advance a theory, are as follows:—

The existence of two heterogeneous polar forces acting in opposite directions, and necessarily connate and co-existent; yet capable of reciprocal neutralization, agreeably to the authority of Faraday and others: the polarity of matter in general, as displayed during the crystallization and vegetation of salts: also as made evident by Faraday's late researches, and the experiments and observations of Hunt: the very small proportion of the space in solids, as in the instance of potassium and other metals, which can be occupied by the ponderable atoms; while, agreeably to the researches and speculations of Faraday (rightly interpreted), the residual space must be replete with imponderable matter. The experiments and inferences of Davy and others, tending to sanction the idea that an imponderable ethereal fluid must pervade the creation: the perfect identity of the polarizing effects, transiently created in a wire by subjection to a galvanic discharge, with those produced by the permanent polarizing power of a steel magnet: the utter heterogeneousness of the powers of galvanic and frictional electricity, as respects ability to produce sparks before contact, and likewise of the polarities which they respectively produce: the superficiality of electricity proper during discharge as well as when existing upon insulated surfaces, as demonstrated by atmospheric electricity when conveyed by telegraphic wires, agreeably to Henry: the sounds observed severally, by Page, Henry, and Mairan, as being consequent to making and breaking a galvanic circuit through a conductor, or magnetizing or demagnetizing by means of surrounding galvanized coils.

*Proofs of the existence of an enormous quantity of Imponderable Matter in Metals.*

29. It has been most sagaciously pointed out by Faraday, that four hundred and thirty atoms which form a cube of potassium in the metallic state, must occupy nearly six times as much space as the same number of similar atoms fill, when existing in a cube of hydrated oxyd of potassium of the same size; which, besides seven hundred metallic atoms, must hold seven hundred atoms of hydrogen and fourteen hundred of oxygen, in all two thousand eight hundred atoms; whence it follows that, in the metallic cube,

there must be *room* for six times as many atoms as it actually holds.

30. With all due deference, I am of opinion that this distinguished philosopher has not been consistent in assuming that, agreeably to the Newtonian idea of ponderable atoms, the space in potassium not replete with metal must be vacant; since, according to facts established by his researches, or resulting therefrom, an enormous quantity, both of the causes of heat and of electricity, exists in metals. Moreover, agreeably to his recent speculations, those causes must consist of material, independent, imponderable matter, occupying the whole of the space in which their efficacy is perceptible. To the evolution of the imponderable matter thus associated, the incandescence of a globule of potassium on contact with water, may be ascribed, since it is the consequence of the displacement of such matter by the elements of water, which, in replacing it, converts the metal into the hydrated oxyd called caustic potash.

31. The existence both of the causes of electricity and heat in metals, is likewise confirmed by the fact, that the inductive influence of a magnet is sufficient to cause all the phenomena of heat, electrolysis and magnetism, as exemplified by the magneto-electric machine. The existence of the cause of heat in metals is also evident from the ignition of an iron rod when hammered, or the deflagration of wire by the discharge of a Leyden battery.

32. The superiority of metals as electrical conductors, may be the consequence of the pre-eminent abundance of imponderable matter entering into their composition, as above alluded to in the case of potassium.

33. Graham, in his Elements, treating of electricity, alleges that the "great discoveries of Faraday have completely altered the aspect of this department of science, and suggests that all electrical phenomena whatever involve the presence of matter." Unless the distinguished author, from whom this quotation is made, intended to restrict the meaning of the word matter to ponderable matter, there was no novelty in the idea that electrical phenomena involve the presence of matter, since the hypotheses of Franklin and Dufay assume the existence of one or more imponderable material fluids. But, on the other hand, if the meaning of the word *matter* is only to comprise that which is ponderable, the allegation is inconsistent with the authority cited. According to the researches of Faraday, there is an enormous electrical power in metals, and according to his speculations, such powers must be considered as imponderable material principles, pervading the space within which they prevail, independently of any ponderable atom acting as a basis for material properties; the existence of such atoms being represented as questionable.

*Electrical Phenomena attributed to Stationary, or Undulatory Polarization.*

34. It having been shown that in electrical discharges there cannot reasonably be any transfer of matter, so as to justify the idea of their being effected either by one current or by two currents, the only alternative seems to be that the phenomena are due to a progressive affection of the conducting medium, analogous in its mode of propagation to waves, as in the case of liquids, or the aërial or ethereal undulations to which sound and light are ascribed. (1, 2, 3, &c. &c.)

35. The idea intended to be conveyed by the word wave, as applied in common to the undulatory affections above mentioned, and that which is conceived to be the cause of the phenomena usually ascribed to one or more electrical currents, requires only that there should be a state of matter, which, while it may be utterly different from either of those which constitute the waves of water, light or sound, may, nevertheless, like either, pass successively from one portion of a mass to another.

36. The affection thus designated may be reasonably distinguished from other waves, as a *wave of polarization*, since the wire acts, so long as subjected to the reiterated discharges of a voltaic series, as if it were converted into innumerable small magnets, situated like tangents to radii proceeding from its axis.

37. But if a polarizable medium be requisite to electrical discharges, since they pass through a space when devoid of *ponderable* matter, there must be some *imponderable* medium through which they can be effected. Hence we have reason to infer that there is an imponderable matter existing through all space, as well as within conductors, which is more or less the medium of the opposite waves essential to electric discharges. Quoting his own language, Davy's experiments led him to consider "that space, (meaning void space,) where there is not an appreciable quantity of this matter, (meaning ponderable matter,) is capable of exhibiting electrical phenomena:" also that such phenomena "are produced by a highly subtile fluid or fluids." Moreover, that "it may be assumed, as in the hypothesis of Hooke, Euler, and Huygens, that an ethereal matter susceptible of electrical affections fills all space."

38. Agreeably to the suggestions above made, all ponderable matter which is liable to be electrified *internally* by electrical discharges, may be considered as consisting of atoms composed of imponderable ethereo-electric particles in a state of combination with ponderable particles, analogous to that which has been supposed to exist between such particles and caloric when causing expansion, liquidity or the aëriform state. Atoms so consti-

tuted of ethereal and ponderable particles, may be designated as ethereo-ponderable atoms.*

39. A quiescent charge of frictional electricity, only affecting the superficies of any ponderable mass with which it may be associated, and having no influence upon the component ethereo-ponderable atoms severally, is not to be ascribed to redundancies or deficiences of the ethereal matter, but to different states of polarization produced in different sets of the particles of such matter existing about the electrifiable bodies.† During the action of an electrical machine, these particles are polarized by the opposite polarities transiently induced in the surfaces subjected to friction; one set of particles going with the electric, the other remaining with the rubber.

40. The particles thus oppositely polarized, severally divide their appropriate polarities with other ethereal matter surrounding the conductors, and this, when insulated, is retained until a further polarization results from the same process. Thus are the ethereo-electric atmospheres respectively surrounding the positive and negative conductors oppositely polarized, and consequently charged to the degree which the machine is competent to induce. Under these circumstances, if a conducting rod be made to form between them a communication, by touching each conductor with one of its ends, the polarities of the ethereo-electric atmospheres by which they are severally surrounded, propagate themselves, by a wave-like process, over and more or less through the rod, according to its nature and dimensions, so as to meet intermediately, and thus produce reciprocal neutralization.

41. When the oppositely polarizing waves, generated by friction, as above described, are by means of a conducting communi-

* Pouillet suggests that when the passage of a ray of light through glass, is influenced by a powerful magnet, agreeably to the experiments of Faraday, "consistently with the undulatory theory of light, it is the ether of the body submitted to the experiment, which would be modified by the magnetism, and that it would be very difficult to recognize whether it is modified without any participation of the ponderable matter with which it is so intimately connected." Thus the existence of matter, composed of ethereal as well as ponderable particles, is sustained by all the evidence which has been brought to uphold the undulatory theory of light.—*L. & E. Phil. Mag., &c. for* 1846, vol. xxviii, p. 335.

† The word statical, has been used to designate phenomena which are the effects of electricity when at rest, as when accumulated upon conductors or the surfaces of panes or jars. Phenomena which are supposed to arise from electricity in motion (forming a current), are designated as dynamic. Thus when charging one side of a pane produces the opposite state in the other, the effect upon the latter is ascribed to *statical* induction; but when a discharge of electricity through one wire, causes a current in another, forming an adjacent circuit, the result is ascribed to *dynamic* induction. This method of designation is employed whether the alleged current be owing to electricity generated by friction, as in the case of a machine, or generated by chemical reaction, as in the case of a galvanic battery. A good word is wanting to distinguish electricity, when produced by friction, from electricity produced by galvano-chemical reaction: for want of a better, I will resort to that employed by Noad (*frictional*), which has the advantage of being self-explanatory.

cation transmitted to the surfaces of a coated pane, the two different portions of the electro-ether, there existing, are severally polarized in opposite ways, one being endowed with the properties usually called vitreous, or positive, the other with those usually called resinous, or negative. In fact, the two polarized atmospheres thus created, may be conveniently designated as the "*two electricities*," and alluded to in the language heretofore employed in treating of phenomena, agreeably to the hypothesis which assumes the existence of heterogeneous fluids instead of heterogeneous polarities.

42. Of course it will follow, that the oppositely polarized ethereal atmospheres thus produced, one on each surface of the electric which keeps them apart, must exercise towards each other an attraction perfectly analogous to that which has been supposed to be exercised by the imaginary heterogeneous electric fluids of Dufay. The electro-ether* being elastic, a condensation over each of the charged surfaces, proportionable to the attractive force, must ensue; while over the surface of an electrified conductor, the similarly polarized atoms not being attracted by those in an oppositely polarized atmosphere beneath the surface, tend, by their reciprocally repulsive reagency, to exist further apart than in a neutral state. Hence, the electro-ether, as it exists over the surface of an insulated conductor, is rendered rarer, while, as existing over the surfaces of charged panes or Leyden jars, it must be in a state of condensation.† And, consequently, while the space perceptibly electrified by the charge of a conductor, for equal areas and charging power, is much more extensive than the space in which the charge of a coated pane is perceptible, the striking distance being likewise much greater; yet upon any body successively subjected to a discharge from each, the effect will be more potent when produced by means of the pane.

*Ignition, Electrolysis and Magnetism, Secondary Effects of Frictional Discharges; or, in other words, of Polarizing Electro-ethereal Waves.*

43. In proportion as a wire is small in comparison with the charge which it may be made the means of neutralizing, the conducting power seems to be more dependent on the sectional area,‡ and less upon the extent of surface. The reciprocal repulsion of the similarly polarized ethereal particles must tend always to make them seek the surface, but at the same time their

* As the word ether is used in various senses, the syllables "*electro*" being prefixed, serve to designate that which is intended.

† See my communication on "*Free Electricity*," in this Journal, vol. iii, ii ser., May, 1847.

‡ The sectional area of a conductor is the area of the superficies which would be exposed by cutting it through at right angles to its axis.

attraction for the ethereo-ponderable particles composing the wire has the opposite effect, and tends to derange these from their normal polar state of quiescence. Commensurate with the extent in which this state is subverted, is the resulting heat, electrolytic power, and electro-magnetic influence. The phenomena last mentioned, are, however secondary effects consequent to the participation of the ethereo-ponderable matter in the undulations resulting from the statical discharge.

44. Such effects, making allowance for the extreme minuteness of the time occupied by the process, are probably, in all cases, proportional to the degree in which the ponderable matter is affected, up to the point at which it is dissipated by deflagration; but the duration of a statical discharge being almost infinitely minute for any length of coil which can conveniently be subjected thereto, the electro-magnetic and other effects of a statical discharge, are not commensurate with the intensity of the affection of the wire.

45. There is, in fact, this additional reason for the diversity between the electro-magnetic power of a statical discharge, as compared with that of the voltaic series: any wire which is of sufficient length and tenuity to display the maximum power of deflagration by the former, cannot serve for the same purpose in the case of the latter. Moreover, the form of a helix closely wound, so that the coatings may touch, which is that most favorable for the reiteration of the magnetic influence of the circuit upon an iron rod, cannot be adopted in the case of statical discharges of high intensity, since the proximity of the circumvolutions would enable the ethereal waves, notwithstanding the interposition of cotton or silk, to cross superficially from one to the other, parallel to the axis of the included iron, instead of pursuing the circuitous channel afforded by the helix with the intensity requisite to the polarization of the ponderable atoms.

*The extreme diversity, as respects striking distance, between the direct effects of Frictional Electricity and those directly arising from Galvanic Reaction.*

46. The intensity of the excitement produced by different electrical machines, is estimated to be as the relative lengths of the sparks which proceed from their prime conductors respectively. Admitting that the relative intensity were merely as the length of the spark, not as the square of that length, still there would be an infinite difference between the intensity of a voltaic series and that of electrical machines, if measured by this test. Large electrical machines, like that at the Polytechnic Institution, London, give sparks at twenty inches and more; while, agreeably to Gassiott's experiments, a Grove's battery of 320 pairs, in full power, would not, before contact, give a spark at *any distance*,

*however minute.* It follows, that, as respects the species of intensity which is indicated by length of sparks, or striking distance, the difference between the electricity of the most powerful voltaic series and electrical machines, is not to be represented by any degree of *disparity;* it proves that galvanism proper and electricity proper are heterogenous.

47. It should be recollected that the intensity of galvanic action, in a series of 320 pairs, excepting the loss from conduction, would be to that of one pair as 320 to 1.* Of course the striking distance of a battery of one pair would be 320 times less than nothing: 320 below zero.

48. We may infer that the undulatory polarization of ethereo-ponderable matter, is the primary, direct, and characteristic effect of galvanic excitement, in its more energetic modifications. Yet, that by peculiar care in securing insulation, as in the water batteries of Cross and Gassiott, ethereal undulations may be produced, with the consequent accumulation of ethereal polarity requisite to give sparks before contact, agreeably to the experiments of those ingenious philosophers.

49. Hence it may be presumed, that during intense ethereo-ponderable polarization, superficial ethereal waves may always be a secondary effect, although the conducting power of the reagents, requisite to the constitution of powerful galvanic batteries, is inconsistent with that accumulation of ethereal polarity which constitutes a statical spark-giving charge.

50. As all the members forming a voltaic series have to be discharged in one circuit, the energy of the effort to discharge, and the velocity of the consequent undulations must be ceteris paribus, as the number of members which co-operate to produce the discharge. Of course the more active the ethereo-ponderable waves, the greater must be their efficacy, in producing ethereal waves of polarization, as a secondary effect, agreeably to the suggestions above made. (49, 36.)

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* According to Colomb's experiments, electrical attraction and repulsion are inversely as the squares of the distances, and the inductive power of statical charges which is produced by those forces, and which precedes and determines the length of the resulting spark, must, of course, obey the same law.

If this calculation be correct, the intensity must be as the squares of the striking distances, as indicated by sparks.

It may be urged, that the striking distances, as measured by the length of the sparks, is in the compound ratio of the quantity and intensity. As to the quantity, however, galvanic sources have always been treated as preëminent in efficacy, so that on that side there could be no disparity. Moreover, I have found, that in galvanic apparatus of only one, or even of two pairs, as in the calorimotors, the intensity lessened as the surfaces were enlarged. By a pair of fifty square feet, of zinc surface, a white heat could not be produced in a wire of any size, however small. The calorific power of such apparatus can only be made evident by the production of a comparatively very low temperature, in a comparatively very large mass

51. Hence in a battery consisting of one galvanic pair excited by reagents of great chemical energy, and conducting power, the electro-magnetic effects are preëminent; while De Luc's electric columns consisting of several thousands of minute pairs, feeble as to their chemical and conducting efficacy, are preëminent for statical spark-giving power (48). This seems to be quite consistent, since on the one hand, the waves of polarization must be larger and slower, as the pairs are bigger and fewer; and on the other hand smaller and more active, as the pairs are more minute and more numerous.

*On the perfect similitude between the Polarity communicated to Iron Filings by a Magnetized Steel Bar, and a Galvanized Wire.*

52. If by a sieve, or any other means, iron filings be duly strewed over a paper, resting on a bar magnet, they will all become magnets, so as to arrange themselves in rows like the links of a chain. Each of the little magnets thus created, will, at its outermost end, have a polarity similar to that of the pole (of the magnet) with which it may be affiliated. Of course the resulting ferruginous rows formed severally by the two different poles of the bar, will have polarities as opposite as those of the said poles.

53. In an analogous mode, if two wires be made the media of a galvanic discharge, iron filings, under their influence, will receive a magnetic polarity, arranging themselves about each wire like so many tangents to as many radii proceeding from its axis. Those magnetized by one wire reacting with such as are magnetized by the other.

54. The affections of the ferruginous particles during the continuance of the current so called, are precisely like those of the same particles when under the influence of the bar magnet. The great discordancy is in the fact, that the influence of the magnet is permanent, while that of the wire is indebted for existence to a series of oppositely polarizing but transient impulses which proceed towards the middle of the circuit from each side, so as to produce reciprocal neutralization by meeting midway.

55. The effect upon the filings, as originally pointed out by Oersted, is precisely what would arise were the ponderable matter of the wire, resolved by each impulse into innumerable little magnets, situated so as to form tangents to as many radii proceeding from the axis of the wire.

56. Independently of the filings, the wires react with each other as if their constitution, during subjection to the discharge, were such as above supposed. When the discharges through them concur in direction, they attract, because the left side of one is next the right side of the other, bringing the opposite poles

of their little magnets into proximity; but when the discharge is made in opposite directions, the two right or the two left sides will be in proximity, and will, by the consequent approximation of the similar poles of the little magnets, be productive of repulsion.

57. From these last mentioned facts and considerations, it must be evident that, assuming that there is in a galvanized wire a derangement of the poles of the constituent ethereo-ponderable particles analogous to that permanently existing in magnetized steel, involves no contradiction, no absurdity, nor any thing but what is consistent with the researches and inferences of Davy, Faraday, and other eminent investigators of the phenomena of nature.

(To be continued.)

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ART. XXXVIII.—*Description of a mass of Meteoric Iron, discovered near Murfreesboro', Rutherford county, Tenn.;* by Prof. G. TROOST.

No state in the Union seems to be so favored with aërolites as the state of Tennessee. The first, the explosion of which is yet recollected by several citizens of Nashville, fell on the 9th of May, 1827, near Drake creek in Sumner county—it is a stone, and notice was taken of it in this Journal. The second, a mass of iron, was discovered in Cocke county. The third, a mass of iron, in Sevier county. The fourth, a mass of iron, in Dickson county; the fall of this mass was witnessed by several persons and took place on the last of July or the first of August, 1835. The fifth, a mass of iron, was discovered in Dekalb county. The sixth, a mass of iron, in Green county. The seventh, a mass of iron, in Smith county. The eighth, a mass of iron, in Jackson county. Two other masses of iron may be ranked amongst the Tennessee aërolites—the one was discovered a few miles beyond the boundary line of Tennessee, in Walker county, Alabama, and the other in Livingston county, Kentucky. All these masses have been described by me in this Journal. To these ten aërolites, I add now an eleventh meteoric mass of iron, discovered a few months since, a few miles from Murfreesboro' in Rutherford county, Tennessee.

The history of its discovery is similar to that of the generality of these meteorites. Nothing is known of its fall: it was accidentally discovered by gold and silver hunters, and being at first considered as containing these precious metals, it was kept a profound secret, till it was found out to be iron, when no difficulty was made to part with it for a pecuniary consideration. When this discovery is made, these aërolites generally get into the

hands of those that know how to appreciate them; and such is also the history of the Rutherford iron.

The mass as it first came into my possession (only a very small part being chiseled off) weighed about nineteen pounds; it had an irregular oval shape, and was surrounded with a crust of about two millimeters in thickness, resembling the brown hydroxyd of iron, the pure metal being here and there visible. This metal has the common lustre of iron—its fracture is very crystalline, and it is very malleable, though harder than any of the Tennessee meteoric iron, having taken longer time to be sawed.

The specimen of it in my collection, weighs ten pounds and fourteen ounces; it has a polished surface of an irregular elliptical form of ten by six inches diameter, exhibiting fine Widmannstatian figures of a rhomboidal and triangular form.

It seems pretty free from intermixture with other matter—only one circular mass of $\frac{3}{10}$th inch in diameter is brought to light on the sawed surface, which, judging from its structure, and the action of acid upon it, I am inclined to consider as sulphuret of iron (magnetic pyrites); on the other surface are two small cavities, one of about $\frac{1}{5}$th and the other $\frac{1}{10}$th of an inch in diameter; with these exceptions, the metal is homogeneous and compact.

From an imperfect analysis to which I have subjected it, it appears to contain less nickel than any of the Tennessee meteoric masses, being composed of 96·00 iron, 2·40 nickel, and 1·60 matter not examined.

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ART. XXXIX.—*New Method of determining the Carbon in Native and Artificial Graphites, &c.;* by Prof. R. E. ROGERS and Prof. WM. B. ROGERS, University of Virginia.

IT is well known that native graphite and the graphite of cast iron resist the usual oxydating agents with great obstinacy. Schafhaeutl, in his elaborate paper on "the different kinds of iron,"* states that "concentrated nitric acid dropped on the red hot graphite (of iron) has not the slightest action on it; neither has sulphuric acid dropped into boiling nitric acid." He found that "with the exception of hydro-fluoric acid, no single chemical liquid seemed to have any action on those scales, and only the most concentrated hydro-fluoric acid slowly attacked them when in a state of most minute division." Similar results have attended our trials with various specimens of native graphite. The method by which Schafhaeutl succeeded in effecting a complete

* Phil. Magazine, vol. xvi.

oxydation, was by dropping nitric acid into hot sulphuric acid surrounding the graphite and then boiling the liquid until all the nitric acid was decomposed. But he adds, it was only after a repetition of the process for the fourth time, that the last trace of graphite had disappeared and the acid remained perfectly clear.

The method about to be described, compared with the preceding, is easy of execution, and if we may judge from our experiments, is capable of yielding uniform and accurate results. We trust, therefore, that it may be thought worthy of the attention of analytical chemists. *As a means of comparing the purity of the different varieties of native graphite*, we have found it entirely satisfactory. As applied to the still more important purpose of determining the entire amount of carbon in the several kinds of cast iron and steel, our experiments have not yet been sufficiently numerous to enable us to pronounce confidently upon its accuracy, but we are not without hopes of making it available also for this object, as a substitute for the very troublesome procedure by organic analysis.

The oxydizing agent employed in this process is a mixture of *bichromate of potassa and sulphuric acid*, which, when applied to the graphite, under the conditions about to be described, converts the carbon rapidly and completely into carbonic acid. The gas being intercepted by a Liebig tube, gives, by the equivalent of carbon, the amount of this substance present in the graphite. The details of the method are as follows:

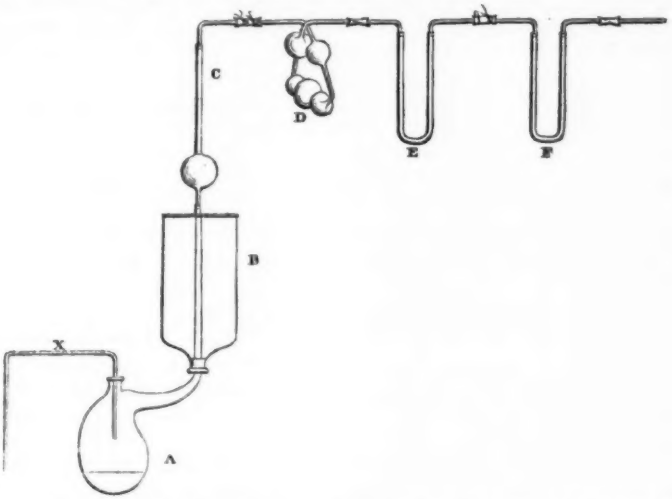
1. *Preliminary treatment of the Graphite.*—As the native graphite not unfrequently contains adhering organic matter and a trace of earthy carbonate, both of which would add to the carbonic acid evolved in the process, it is proper after reducing the mass to a coarse powder, to moisten it with dilute sulphuric acid, and expose it to a red heat for a few minutes. It must then be brought to a state of *extremely minute division*. This great comminution, which is indispensable to prompt and entire oxydation, can not be affected by grinding in the usual way, as the graphite thus treated, forms flakes or plates under the pestle. But the requisite subdivision is readily attained by grinding it in a Wedgewood mortar with pure quartzose sand, or what is better with small fragments of granular quartz. The material we use for this and other similar purposes, is a very pure white granular quartz, found in a thick vein in the neighborhood of the University. It readily yields under the pestle, and may be reduced in a few minutes to an almost impalpable powder. Pumice stone we have found equally efficient, though somewhat more difficult to break down. Any trace of the graphite that may adhere to the mortar, is completely washed out by trituration with a small additional portion of the siliceous matter.

To obtain the requisite subdivision we use a weight of the silica, from thirty to thirty-five times that of the graphite, adding it at intervals, as the materials in the mortar begin to assume the adhesive or caked condition which seems to mark the limit of the reducing action of the pestle. It is important to bear in mind that the success of the oxydating process we are describing, is almost wholly dependent upon this preparatory step. In our early experiments with the graphite, ground in the ordinary way, we found the reaction with the oxydating agents so slow as to leave little hope of a satisfactory result. After a digestion of twelve hours with the aid of heat, numerous specks of the unchanged material were still found at the bottom of the vessel. But when, by the process just mentioned, the graphite is brought to very minute division, *the oxydation is completed in from thirty to forty minutes.*

2. *Mixture of the Materials.*—With an apparatus of the dimensions to be described under the next head, six grains of the purer kinds of graphite is a convenient quantity for experiment. This is triturated with two hundred grains of granular quartz, until the whole is reduced to such extreme fineness that no glimmering points of graphite can be discovered in the mass under a strong light. Five hundred grains of bichromate of potassa, previously powdered, must now be mixed intimately with the silica and graphite by grinding in the mortar. Introducing the mixed powder into the retort we add one cubic inch of water, and after suffering the liquid thoroughly to penetrate the mass, we pour upon it, slowly, five cubic inches of sulphuric acid of the ordinary density, using occasional agitation as we proceed. The reaction may be aided by a gentle lamp heat applied a few moments at a time; but it soon becomes as rapid as desirable, the carbonic acid passing into the absorption tube and the liquid acquiring a greenish color around the edges where the adhering particles of graphite are greedily consumed. During the process, the lamp heat is to be renewed, whenever necessary to maintain a steady moderate stream of gas, and in closing the operation, it should be applied for several minutes, to favor a copious evolution of oxygen, which, driving most of the carbonic acid before it, diminishes the necessity of a long continued aspiration at the end.

The *large excess* of bichromate of potash and sulphuric acid used in this process, is requisite to ensure a prompt and complete oxydation. Any further dilution with water retards the action. The sulphuric acid, in the proportion mentioned, is adequate, not only to secure an abundant development of chromic acid, but to maintain the mixture in a sufficiently fluid state to prevent any serious intumescence while the oxydation is going on.

3. *Apparatus used in the Process.*—This will be understood from the accompanying diagram and description.




A is a glass retort having a capacity of about thirty cubic inches, which we have found large enough for operating conveniently on six grains of pure graphite. Its beak is bent obliquely and then vertically upwards so as to present an erect stem for about twelve inches, which is enclosed by a glass jar B nearly filled with water. This is designed to condense any vapor of sulphuric acid, which may be evolved from the mixture at a high temperature, and which by passing into the adjoining chlorid of calcium would liberate hydrochloric acid and thereby increase the weight of the potash tubes. The drying tube C, about ten inches long, is charged in the straight part with dry chlorid of calcium and in the bulb with loosely packed cotton, and is joined to the beak of the retort by a cork and cement. D is a common Liebig tube, containing the standard solution of potassa, and E is a small U tube charged with fragments of potassa, having at each end a little flock of cotton. The latter serves to intercept any carbonic acid which might escape absorption in the Liebig tube. The amount thus passing which is extremely small, is entirely arrested before reaching the second U tube, F. This is added to prevent the reflux of $CO_2$ or aqueous vapor into the preceding tubes, during the slight *recoiling* pulsation caused by the intermitting transit of the bubbles. The remote end of F communicates with a large aspirator, through the medium of a leaden tube and gallows screw, as so usefully and variously applied by Dr. Hare.

The connections from C to the aspirator are of gum elastic tube. D and E are united above by a thin wire with a hook, for convenience of suspension in weighing them together, before and after the operation. In the tubulure of the retort, passing through a tight cork, is a slender glass tube X, doubly bent and descending nearly midway. It is drawn out to a long taper and hermetically sealed at the far end. Its chief use is to admit a current of air during the aspiration, which forms the closing step of the experiment. But it is also useful as a means of introducing more sulphuric acid, should we find, late in the process, that enough has not been added to complete the oxydation of the graphite. This is done by removing the tip of the tube X with a file, and bringing a vessel containing sulphuric acid up around the open end. The aspiration gently draws the liquid into the retort, and now the opening of the tube may be stopped by a little ball of softened wax or cement. As however with the proportion of materials previously stated, such a recharging will scarcely ever be necessary, this appendage may be replaced by a vertical tube similarly sealed, to be opened only for the final aspiration.

4. *Mode of Manipulation.*—On this head little need be added to what has been included in the preceding details. A brisk but not too violent evolution of $CO_2$ is to be maintained, by applying or withdrawing the heat, and by occasional slight agitation. Soon after the last remnants of carbon have been consumed, the bubbles in their passage through the Liebig tube indicate by their persistent volume the completion of the oxydation. But as a further security we accelerate the evolution of oxygen by the lamp, and continue to maintain this stream of passing gas for several minutes.

We now remove the neb of the tube X, and by aspiration pass slowly through the apparatus a volume of air some two or three times the capacity of the retort and connections. The potash tubes may then be removed and weighed.

Where there is doubt as to the completeness of the oxydation, and indeed as a means of assurance generally, the contents of the retort should be transferred to a large porcelain dish by repeated washings. After copious dilution the insoluble matter quickly subsides, and the liquid can be almost entirely removed with a syphon. Should even a very minute quantity of the graphite remain unconsumed, it can be readily detected either with the naked eye or with a magnifier, in consequence of the strong contrast of its color with the whiteness of the siliceous powder. In this way we have found that an amount of the divided graphite can be discerned, so small that, estimating it as carbonic acid in the absorption tubes, it would not affect sensibly a good balance. At the commencement of the experiment and before adding

the sulphuric acid, the usual precautions are observed to ascertain the closeness of the junctures, by using the aspirator.

5. *Results of Analyses made by this Process.*—The details which follow include the analyses of three varieties of native graphite, differing in purity, two specimens of kish or the graphite of iron, and a specimen of a peculiar carbonaceous sublimate deposited during the combustion of native carburetted hydrogen gas.

*Native Graphite*, (*a.*)—The mineral here referred to is a beautiful crystalline variety, found associated with more massive impure graphite, in a very micaceous gneiss, in Albemarle county, Virginia. It consists of long flat narrow plates or prisms, arranged parallel to one another in close bundles of a curved form, presenting a structure somewhat resembling that of certain thin veins of asbestus. Between the plates are occasional thin partings of brown siliceous matter, but the body of each crystal appears to be perfectly pure graphite.

Six grains of this material reduced to an extremely fine powder with the granular quartz, yielded by oxydation, carbonic acid, 20·76 grains. A second experiment with a like quantity gave, carbonic acid, 20·82 grs.

From the near coincidence of these results, we may safely assume the mean 20·79 as a basis for computing the carbon in the mineral. We infer therefore that this graphite contains in 100 grs., carbon, 94·5 grs.

*Native Graphite*, (*b.*)—This is a compact massive variety, from Cumberland, seemingly very pure.

Six grains yielded, in two successive experiments—first experiment, carbonic acid, 20·35 grs.; second experiment, carbonic acid, 20·31 grs. Assuming the mean 20·33 for computation, we have in 100 grs. of this graphite, carbon, 92·4 grs.

*Native Graphite*, (*c.*)—A portion of the massive variety associated with (*a.*) It contains earthy matter and interspersed scales of mica, with grains of partially decomposed felspar.

Six grains treated as before, yielded, carbonic acid, 14·36 grs. This corresponds in 100 grs. of the graphite, to carbon, 65·4 grs.

In all these experiments the oxydation was completed in about thirty minutes.

*Kish*, (*a.*)—This material was in very thin crystalline plates, not acted on by the magnet.

Six grains in two successive experiments gave—first, carbonic acid, 20·50 grs.; second, carbonic acid, 20·42 grs. The mean of these results, 20·46 grs., corresponds in 100 grs. of the kish, to carbon, 93 grs.

*Kish*, (*b.*)—This specimen was in larger flakes, with adhering iron and slag. Before submitting it to experiment, it was digested for some hours in hydrochloric acid to remove the iron, and

was then washed and dried. It still retained much adhering siliceous matter, as became evident in crushing it with the pestle.

Six grains in two successive experiments gave—first, carbonic acid, 16·58 grs.; second, carbonic acid, 16·65 grs. The mean of these numbers, 16·61, corresponds in 100 grs., to carbon, 75·5 grs.

*Black Carbonaceous Sublimate.*—This material was collected from the interior of a flue used for burning the native carburetted hydrogen, so extensively employed some years ago as a fuel, at many of the salt-works in the Kenawha Valley, Virginia. It is very light, of a spongy texture, harsh to the touch, hard enough where most compact to scratch glass, and of a deep black color externally, passing into greyish black within.

Finding by some preliminary experiments, that it resisted oxydation even *more powerfully than graphite*, we subjected it to still longer trituration with the silica than we had found necessary with the graphite, and we employed in the oxydation a somewhat greater excess of sulphuric acid than in the preceding cases. The evolution of $CO_2$ did not begin until the lamp had been applied for several minutes, and its progress was much slower than with the graphite, the complete oxydation requiring nearly an hour.

Six grains of this material, previously well calcined to remove moisture or other volatile matters, yielded carbonic acid, 21·62 grs.; corresponding in 100 grs. of the calcined sublimate, to carbon, 98·2 grs.

As a means of testing in some measure the accuracy of the process above described, the following experiments were made to determine the carbon of the graphite (*a*) and the black sublimate, by burning a weighed quantity of these substances in oxygen.

The apparatus employed for burning the graphite was a spacious platinum crucible, through the cover of which was passed a pipe connected with an oxygen gasometer so as to supply a gentle stream of this gas to the ignited materials. By previous trials, it was found that the black sublimate could be readily burned in a current of oxygen passed over it in a tube of refractory glass, and this method was accordingly used for its oxydation.

Before triturating the graphite with the silica, the latter was intensely ignited to drive off the trace of moisture which it had been found to contain. Twelve grains of graphite (*a*) thoroughly ground with the silica thus prepared, were exposed in the platinum crucible to a bright red heat, the interior being supplied continually with oxygen from the gasometer. In about fifty minutes the carbon of the graphite was entirely consumed. The residue had a faint brownish tint, while the unmixed silica similarly ignited, was found to retain its original whiteness almost unaltered. This slight colorarion of the former was doubtless due to the trace of iron present in the graphite.

The loss of weight sustained by the contents of the crucible, was 11·30 grs. Considered as due entirely to the burning of the carbon, this would give for the 100 grs. of graphite, carbon, 94·16 grains.

Twenty grains of the sublimate in coarse powder, weighed after strong calcination, were deposited in the trough of a bent slip of mica, and in this position, introduced into a tube of Bohemian glass, drawn to a small orifice at one end and adapted at the other to the pipe of the oxygen gasometer. After raising the material to a low red heat by a lamp applied beneath the portion next the gasometer, a *very gentle* current of oxygen was allowed to pass along the tube. A steady combustion without scintillation was thus maintained, which traveling slowly to the remote end of the carbonaceous matter in the mica trough, reduced the whole in a few minutes to a light greyish ash. The mica was then withdrawn, and the ash on weighing, amounted to 0·33 grains. It showed by tests a scarcely sensible trace of iron, and consisted almost wholly of silica.

Regarding the sublimate as made up of this and carbon—we have with 100 grs., earthy matter, 1·65 grs., and carbon, 98·45 grs.

Comparing now the results by the new oxydating process with those obtained by ignition in oxygen, we have,

| | New Process. | Ignition. |
|---|---|---|
| Fibrous Graphite, | 94·56 | 94·16 |
| Black Sublimate, | 98·29 | 98·45 |

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## Art. XL.—*Parallelism of the Palæozoic Formations of North America, with those of Europe.**

(Continued from p. 183.)

When we are able to follow without interruption the strata of one country to another, we easily succeed in connecting them together and showing how they correspond. But when, on the contrary, two continents are separated by a vast sea, we have

* Since the geology of the United States has attracted attention, it has been the endeavor to compare the sedimentary deposits of that country with those of Europe; but it is only since the publication of the Silurian System of Mr. Murchison, that this has been done with some success. If the limits within which we are forced to restrict ourselves at this time, do not permit us to notice the attempts of this kind by Messrs. Conrad, Dale Owen, Rogers, Troost, Jackson, and by the geologists of the state of New York, it is not because we do not acknowledge their merit. On the contrary, no one more than ourselves, and we wish to express it, admires the great works published within a few years by the American geologists. We would above all, praise the wise independence with which they have first studied their own ground, without being preöccupied with that of Europe. This part of their works is almost always irreproachable. In regard to the relation of the sedimentary deposits of the two continents, we hope that they will pardon us the slight changes which the comparative study of the fossils induces us to propose.

no other means than to study in each of them a series of beds comprised between two known and well determined points, to compare their fossils, to seek out the identical species, and to see if these species are distributed according to the same law. If it happens that in the two countries a certain number of systems, characterized by the same fossils, are superimposed in the same order, whatever may be, otherwise, their thickness and the number of physical groups of which they are composed, it is philosophical to consider these systems as parallel and synchronous. This is precisely what we intend to do in this place. The sections of sedimentary deposits which we will compare in the two countries, comprise the most ancient fossiliferous beds, and extend to those which contain the coal. They are of equal value; and if we succeed in establishing, that there exists in America a certain succession of systems or stages disposed as in Europe, and characterized by the same fossils, we shall have, it would seem, sufficiently proved that they are parallel.

One of the principal difficulties of the subject arises from this, that in North America the Palæozoic formation is more complete than in Europe. We have seen, in fact, that it is composed of a series of deposits, concordant among themselves, and which are connected together in such a manner that it is difficult to trace marked divisions. It thence results that the limits which correspond to different systems of Europe must, in certain cases, offer some uncertainty; but this uncertainty is attended with little inconvenience if we are able easily to recognize and to place in parallelism, the middle parts of each system. In truth, the important point is to assure ourselves, that during the Palæozoic period the animal kingdom has suffered, in the two continents, simultaneous transformations, so that identical species occupy corresponding positions. It is this which gives to Palæozoic characters that generality of application which constitutes their value, and this is also, the easiest part of our task.

The series of Palæozoic deposits, being, as we have said, more complete in America than in Europe, the comparison which we shall endeavor to make, may throw light upon some contested points of European classification, and furnish certain links which are wanting to us.

The comparison of Europe with North America will have still this great advantage, of determining, among the groups of which each of our systems is composed or each of the great divisions of the Palæozoic formation, those which have the greatest importance by their constancy and the facility with which they are recognized in all countries. We shall thus see that these groups are, in the inferior stage of the Silurian system, the Orthoceratite limestone of Sweden and Russia; in the superior stage, the limestones of Wenlock and of Gothland; in the Devonian system, those of the Eifel, of Brittany, of Devonshire, etc. etc.

*Silurian System, (inferior stage.)*—This stage is represented in the United States by the first six groups of the New York series. The Potsdam sandstone with Lingula is probably analogous to the sandstone with Obolus of Russia and the lower sandstones of Scandinavia.* These are in the two continents, the most ancient fossiliferous rocks, and, when we reflect upon their antiquity we are astonished to meet with a genus of shells which appears still in the existing creation, which prove that the conditions of existence were not very different then from those of the present time.

The *siliceous limestones*, those of Black River and of Trenton, are the equivalents of a great part of the inferior Silurian stage of Europe, and they occupy the same position as the bituminous schists and the Orthoceratite limestones of Sweden and Russia. The Utica slate and the Hudson River group, with the Graptolites at their base, represent the Graptolite slates, which in Sweden succeed to the red Orthoceratite limestone. They are also the same as those of Bain in France.

This succession of deposits in America, contains a large quantity of fossils,† among which we have recognized seventeen species which in Europe are found in the inferior stage of the Silurian system, viz., *Calymene Blumenbachii, C. Fischeri, C. punctata, Illænus crassicauda, Lichas laciniata, Ceraurus pleurexanthemus, Trinucleus caractaci, Phacops Dalmani, Orthoceratites communis* or *duplex, Lituites convolvans, Bellerophon bilobatus, Spirifer lynx, Orthis testudinaria, O. Verneuili, Stromatopora concentrica, Ptilodictya lanceolata* and *Chætetes petropolitanus.* With the exception of *Calymene Blumenbachii, C. punctata, Spirifer lynx, Stromatopora concentrica* and *Ptilodictya lanceolata*, which rise more or less into the superior beds, the species which we have enumerated may be considered as characteristic of the lower Silurian stage in both continents.

The great proportional number of the Trilobites, gives us an idea of the considerable development already made by this family, and which corresponds to what is observed in Europe. But besides the identities of species, there are still certain analogies of genera which we see often manifested in deposits of the same epoch. We will cite here, as an example, the genus *Isotelus*, which in America represents our *Asaphus*, with eight articulations, and which like them is proper to the inferior stage of the Silurian system.

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* According to Professor Sedgwick, the most ancient fossiliferous rocks of Wales would be also, like those of America, characterized by Lingula and Fucoids.—(Journal Geol. Society, vol. iii, p. 157.)

† The first volume of the Palæontology of New York, by Mr. Hall, which is about to appear, will be entirely devoted to a description of the fossils of the groups which, according to us, correspond to the inferior Silurian stage of Europe; it will contain more than eighty plates. The talent and the profound knowledge of the author, gives sufficient assurance of the interest which it will have for science.

The Orthoceratites, which by their large lateral syphon, empty or furnished with a tube in the interior, form a type so remarkable that Mr. Hall calls them *Endoceras*,* are equally characteristic of this system, both in Europe and America, and do not appear to have prolonged their existence into the superior Silurian epoch. They are as abundant in the Trenton beds as in the Orthoceratite limestones of Sweden and Russia, and we think there must be many identical species in the two countries, although we have yet recognized but one.

The Bellerophons date their existence also from the first periods of creation, and we find nearly as many of them in America as in Europe. The most interesting for us is the *B. bilobatus* of the Trenton limestone, which is certainly the same as that which is found in the lower Silurian limestone of Christiana, or in the contemporaneous sandstones and schists of Wales.

With the Trilobites and the Orthoceratites, the Brachiopods, by their variety of forms, are of all the fossils of this epoch, those which contribute most to give a peculiar stamp to the primitive fauna of the globe. The *Orthis*, the *Leptæna* and the *Terebratulæ*, are the only ones in America as in Europe, which have existed from the earliest times. The other genera, such as *Spirifer*, *Pentamerus* and *Productus*, do not appear until later. The *Orthis* with simple plaits, so distributed through the lower Silurian beds of Europe, are represented in America by the *O. tricenaria* and *O. pectinella*, Conr.; both of them near the *O. calligramma* of Russia and Sweden. The *Orthis testudinaria* and *O. Verneuili* are equally characteristic of the inferior stage of the Silurian system, on both sides of the Atlantic; the *Spirifer lynx*, which we consider as intermediate between the Spirifer and Orthis, passes from this same stage as far as the Clinton group, and is equally found in England from the Wenlock slates to the inferior Silurian beds. Finally, among the zoophytes, the *Chætetes petropolitanus* is the only one which is very abundant in every country, without ceasing nevertheless to be characteristic. The *Stromatopora concentrica* and the *Ptilodictya lanceolata* are not found in Europe before the superior stage of the Silurian system.

The Trenton limestone is separated from the Medina sandstone by powerful beds of sandstones and conglomerates without fossils.† The Medina sandstone itself contains very few, so that when we arrive again at fossiliferous beds, that is to say, those of Clinton, the organized creatures have suffered in the succession

* The *Orthoceratites bisiphonatum*, Sow., of the Caradoc sandstone, belongs, without any doubt, to this type.

† By the use of the term Trenton limestone in this place, M. de Verneuil intends to include not only that limestone, but also the Utica slate and Hudson River group.—J. H.

of ages such modifications, that we find the fauna entirely new. This is one of the principal reasons for placing the Clinton group in the superior Silurian stage, and to make the line of separation between the two stages, below the great mass of the Medina sandstone and Oneida conglomerate. In doing thus we agree nearly with the geologists of New York, and we may observe that that which they call the Champlain division, if we separate the sandstone which terminates it, is the equivalent of the inferior stage of the Silurian system of Europe.*

In the states of Ohio and Indiana, the difference between the Trenton and Clinton groups is, as we have explained, much less marked, in consequence of the absence of the sandstones of New York. The yellow limestone of Dayton, (Ohio,) and some lower beds of cliff limestone, unite together the two grand divisions of the Silurian system. Thus at Dayton, with the true species of the lower division, are found the *Ptilodictya lanceolata* and fragments of the *Phacops caudatus*, species which are characteristic of the upper section, while at Springfield, Ohio, with the *Calymene punctata*, *Bumastus Barriensis*, *Sphærexochus mirus*, *Phacops limularus* or *caudatus*, *Spirifer cyrtena*, *Pentamerus oblongus and Cornulites serpularius*, which are species of the upper Silurian, are found the *Spirifer lynx*, *Terebratula capax* and *Calymene Blumenbachii*, of the blue limestone, which represent the period of the lower Silurian. Near Galena upon the upper Mississippi, the line of separation of the two divisions is yet more obscure, and there the distribution of fossils is not in harmony with the mineralogical differences. The blue limestone and the magnesian limestone are still found, but they do not correspond exactly, as in the state of Ohio, with the two great epochs of the Silurian system. The magnesian limestone thickens at the expense of the blue limestone, and at its base it contains for the most part the fossils of the latter.

With our limitations, the lower epoch of the Silurian system has a very great extension in North America. Commencing at the island Anticosti, it follows the borders of the St. Lawrence, passes to the north of the Lakes Ontario, Huron, Michigan, and reaches the Mississippi at Dubuque, Iowa. To the south, it follows in the same way the outline of the great Palæozoic basin even to Alabama. Finally, in the midst of that great basin, it forms two large islets of which Cincinnati and Nashville are the centre, and which seem to have been slowly elevated above the waters of the sea, during the deposition of the more recent beds.

* This very natural division has been recognized in the Palæontology of New York, vol. i, and will be more fully shown in vol. ii, where the intimate relations of the Medina sandstone and Clinton groups are clearly pointed out.—J. H.

*Silurian System, (superior stage.)*—We comprise under this title, with the sandstones which terminate the Champlain division, three groups which the geologists of New York unite under the Ontario division, and we join to it a part of the Helderberg division as far as the Oriskany sandstone exclusive. This last part is of little importance, being limited to the territory of New York,* while the Clinton and Niagara groups which compose the Ontario division, occupy an immense extent in the western regions of the United States. If we compare these groups with those which constitute the upper Silurian stage in Europe, we cannot for an instant doubt, that the limestones and shales of the Niagara group are the exact equivalents of the limestones and slates of Wenlock and of Gothland; so great is the number of identical species. Hence it follows that the Clinton group, with the *Pentamerus oblongus*, represents the extreme upper part of the Caradoc sandstone, or a stage intermediate between the Wenlock and Caradoc beds; while the five inferior groups of the Helderberg division represent the rocks of Ludlow. The *Pentamerus oblongus*, this fossil so widely distributed in America and in Europe, occupies always the same horizon, and is everywhere found at the junction of the two divisions of the Silurian system; except that in England it is placed in the inferior stage, while in America it forms rather a part of the superior stage.†

The identical species between Europe and America are here more numerous than in the preceding stage. We have recognized the following species: *Calymene Blumenbachii, C. punctata, Phacops Hausmanni, C. limulurus, Bumastis Barriensis, Homalonotus delphinocephalus, Cheirurus insignis, Sphærexochus mirus, Agnostus latus, Orthoceratites annulatus, Bellerophon dilatatus, Terebratula cuneata, T. deflexa, T. reticularis, T. aspera, T. hemispherica, T. tumida, T. Wilsoni, Pentamerus oblongus, P. galeatus, Spirifer cyrtæna, S. trapezoidalis,*

* We presume M. de Verneuil alludes to the western extension of the Oriskany sandstone, for it has been shown by Prof. Rogers to be of great thickness and importance in Pennsylvania.—J. H.

† "In the Western States the *Pentamerus oblongus* appears to have prolonged its existence into the Niagara group; at least, it is often very difficult to distinguish from this group the limestones which contain it." I have shown in the Report on the Geology of New York and elsewhere, that in its western extension the Clinton group becomes more calcareous, losing entirely its arenaceous members and iron ores and almost entirely the shaly portions. At the same time the limestones of the Niagara and Clinton groups assimilate in character to a great degree, so that it becomes difficult to distinguish the limits of the two groups. From an examination of specimens from England, I can have little doubt but the *Pentamerus oblongus* is there as truly separated from the Caradoc sandstone as it is in New York from the Hudson River group, and that the breccia and conglomerate of the Caradoc stage should be regarded as its true upper termination, or more properly should be regarded as we do the Oneida conglomerate, as the commencement of the second stage in the system. I have expressed this opinion in the first volume of the Palæontology of New York and elsewhere.—J. H.

*S. sulcatus*, *S. crispus*, *S. bilobus*, *S. lynx*, *Orthis elegantula*, *O. hybrida*, *Leptæna depressa*, *L. subflava*, *L. transversalis*, *Hypanthocrinites decorus*, *Favosites gothlandica*, *Porites interstincta*, *Catenipora escharoides*, *Stromatopora concentrica*, *Fungia gothlandica*, *Cornulites serpularius*, and *Tentaculites ornatus*.*

The number of Trilobites proves that the family was still flourishing at this epoch. Some species are rare and limited to groups of small thickness, which they characterize with much exactness; such are the *Phacops Hausmanni*, *Sphærexochus mirus* and *Cheirurus insignis*, which are found in Bohemia and in Ireland. The Orthoceratites are less abundant than in the preceding system; the *O. annulatus* is the only identical species which we have observed. The *Bellerophon dilatatus* which we have discovered at Chicago, Illinois, is one of the very characteristic shells of the Wenlock period. Among the eight species of Terebratula here cited, the most interesting are the *T. marginalis*, *deflexa*, *Wilsoni*, *reticularis*, and *aspera*. The last two which appear for the first time, are represented only by little variety proper to the Silurian system.† The two Pentameri are perfectly well known; the *P. galeatus* in Europe is both Silurian and Devonian, while in America it is limited to the first system. The species worthy of attention among the *Spirifers* are the *S. crispus*, *S. sulcatus*, *S. bilobus* and *S. cyrtæna*, which are so abundant in the island of Gothland. The *S. cyrtæna* is the type of a little group of species always very finely striated, with or without longitudinal plications, to which belongs the *S. niagarensis*, and which is characteristic of the superior stage of the Silurian system. The *S. lynx*, so abundant in the preceding period, becomes here very rare. The *Orthis hybrida* and *elegantula* are the same shells which we have found in the upper Silurian stage of Europe. The first occurs in the beds of the Helderberg, which we compare to the Ludlow rocks.‡ Among the *Leptænæ*, there is only the *L. transversalis* which is exclusively proper to the system of which we speak; the *L. subplana* appears to exist in the Devonian beds of Néhon in France, and the *L. depressa*, by a very rare exception, traverses all the Palæozoic strata.

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* We shall have, in another place, an opportunity of giving the reasons for a difference of opinion regarding the identity of some of the species here named, with those of Europe, and with those of the lower division. The first two, *Cal. Blumenbachii* and *C. punctata*, are not identical with those cited by the same name from a lower position, neither is it certain that either of them is identical with the European species of the same name; we are quite sure that the latter is distinct. We shall speak of others in the succeeding pages.—J. H.

† M. de Verneuil has been more fortunate than ourselves in finding the T. aspera in any beds below the Oriskany sandstone.

‡ The *Orthis hybrida* of the Niagara group and the similar form found in the Helderberg are positively distinct species.—J. H.

It is at the upper Silurian epoch, that in America as with us, appear those large corals capable of constructing veritable reefs, such as the *Favosites Gothlandica* and *alveolaris*, the *Catenipores* and the *Porites interstincta*, etc. etc. The epoch is also that of the appearance of the *Tentaculites*,* and of the extinction of the *Graptolites*. In conclusion, of the forty identical species which are found in the superior stage of the Silurian system in America and in Europe, thirty-two have lived neither before nor afterwards, and establish the most perfect correspondence between this part of the Silurian system of Europe and the beds which we assimilate to it in America.

As to the geographical extent of this stage, it is at least equal to that of the inferior stage. The rocks of which it is composed, are particularly developed in the peninsula of Upper Canada, in the states of Ohio, Indiana, Tennessee and Illinois, in the islands of Lake Huron, and upon the shores of Lake Michigan. The abundance of magnesian limestones is there truly remarkable.†

*Devonian System.*—This system comprises the five superior groups of the Helderberg division, the six groups of the Erie division, and the old red sandstone. Whatever be its thickness in the state of New York, it is represented in the western states only by black schists, by the shelly limestone, and by the upper coralline limestone, both very thin, and forming the upper part of the *cliff limestone*.

The point in America where we should place the inferior limit of the Devonian system, is difficult to be determined; Mr. Conrad has placed it below the Portage group. In our work upon Russia, certain considerations induced us to believe that it should be placed below the Tully limestone; but when during last summer we studied, in place, the ensemble of the fossils of the Hamilton group, and recognized a part of those of the Eifel, we saw that it was necessary to comprise in the Devonian the shales of Hamilton and Marcellus. This was not enough, and our journey in the western part of the United States furnished us the proof that the Devonian system extended still lower. In fact, the superior part of the cliff limestone, which in the states of Ohio and Indiana represents the beds of the state of New York called corniferous and Onondaga limestones, contain at Columbus, Ohio, at Lewis Creek, Indiana, at the rapids of the Ohio, fishes analogous to those of our Devonian system. These fossils are associated with shells identical or analogous with those which

* In England the Tentaculites are found, it is said, in the Caradoc sandstone, but not in the lowermost beds of the Silurian system. M. Salters thinks that these animals are allied to the Dentaliæ.

† We may remark in this place, that several of the higher members of this stage are, to us, unknown in the western states, being fully developed only in the eastern part of New York, while the lower members are in great force over those portions of country here cited by M. de Verneuil.—J. H.

we find in Europe in the Devonian system. These are, first, *Goniatites* corresponding to those of the Duchy of Nassau, then the *Murchisonia bilineata*, *Chemnitzia nexilis*, *Lucina proavia*, *L. rugosa*, *Terebratula aspera*, *T. reticularis*, (large variety,) *T. concentrica*, *Spirifer heteroclitus*, *S. cultrijugatus*, *Spirifer* allied to *S. ostiolatus*, *Chonetes nana*, *Productus subaculeatus*, and *Pleurodyctium problematicum*. The corniferous and Onondaga limestones should then be ranged in the Devonian system; and the appearance in these beds, both at Columbus and at the rapids of the Ohio, of the genus *Pentremites*, the existence of which at the Silurian epoch is very problematical, still further confirms the justice of this classification.* To return to the state of New York; the occurrence of the fragment of a fish of the genus *Asterolepis*, found by Mr. John Gebhard in the Schoharie grit, induces us still further to lower the inferior limits of the Devonian system. But should we rest there? or must we yet include the Oriskany sandstone? After much hesitation we adopt the last, from two reasons; the first is, that following the opinion of Mr. Hall, the deposit of the Oriskany sandstone appears to have been preceded by a violent movement of the waters, which denuded the soil and wore the depressions where it accumulated; the second is, that certain fossils have also some analogy with the Devonian fossils, such as that mass of large *Spirifer* totally unknown in the Silurian rocks. Two among them, of which we have seen only the casts, remind us of the *Spirifer cultrijugatus* and *S. macropterus* of the schists of the Eifel.

The Devonian system being thus constituted, we must seek to place in parallelism its different stages with those of Europe. It is incontestible that the red sandstone which forms its superior part, and which is so powerful on the frontiers of the states of New York and Pennsylvania, is upon the same horizon as the old red sandstone of Scotland and Wales. It is here also a local formation, more powerful than extensive, and which contains only the remains of fishes.† The groups of Chemung,

* "We may observe that certain Cyrtoceratites remind us of known forms of the Ludlow rocks."

† We regret that M. de Verneuil should not have given more importance to this *red sandstone*, instead of merely representing it as the terminal group of the Devonian system. This probably accords well enough with the subdivisions adopted in Europe, where there is much more difficulty in defining the limits of groups and proving the order of superposition. After the change which takes place at the termination of the Hudson River group, there is perhaps nowhere else in the entire Palæozoic series so complete a change in the lithological and Palæozoic features of the strata, as at the termination of the Chemung group. Over a considerable extent in New York and Pennsylvania, the Chemung group is succeeded by a coarse sandstone or conglomerate, which lies at the base of the red sandstone. This change is equally great with that which took place at the production of the Oneida conglomerate, and the mass forms a distinct topographical feature in the southern part of New York, and in parts of Pennsylvania. At the same time all the peculiar organic forms of the Chemung group have become extinct, and we

Portage, Genesee, Tully and Hamilton represent to us the formations of the Eifel and of Devonshire; the Marcellus shales are the equivalents of those of Wissenbach in the Duchy of Nassau, as is proved by their Goniatites, so analogous in form.

All the groups which we have examined in the Devonian system of America, are not those which are of the most importance, since the most part of them disappear in advancing towards the west. The most constant beds are the corniferous and Onondaga limestones, both of which contain many species of the limestone of the Eifel and the Hartz, and should be parallel to its inferior part. As to the Oriskany sandstone, as we have said, we are led from the character of its Spirifers to consider it as the equivalent of the fossiliferous schists on the borders of the Rhine.†

The comparison which we have made of the different stages of the Devonian system in America with that of Europe leads to many interesting results. The first is, to remove all species of doubt from the classification of the limestones of the Eifel, the Hartz, &c., in showing the place which their equivalents occupy in the American series; the second is, to demonstrate the little importance of the Ludlow stage, represented solely by some small groups, which scarcely extend beyond the limits of the state of New York, and perhaps of Pennsylvania;‡ the third, in fine, is

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have never seen a Brachiopod of any species in the red sandstone, the entire list of species so far as known being of some five or six fishes, a single shell of the form of Modiola, and a few plants. When we undertake to mark the limits between systems, at points where it is difficult to decide them either from lithological or organic characters, (as in the separation of Devonian and Silurian,) it seems to us very proper to give more importance to such a remarkable line of separation as that indicated at the base of the red sandstone. We have long been satisfied that this mingling of *Brachiopods*, *Acephala*, *Trilobites*, etc. etc. with the remains of a multitude of fishes forming a Devonian system, has nowhere its existence in nature, unless our inferences from widely extended localities are very erroneous.

The relations between the red sandstone and the carboniferous system appear to be scarcely known at all, or whether there may or not be a more intimate relation between this mass and the succeeding grey sandstones has never been shown. We know that between the Chemung group and the great carboniferous limestone of the west and southwest, there is an extensive formation of yellow sandstones and green shales and shaly sandstones, charged with fossils having a close analogy with those of the groups below. No one has yet pointed out the characters that shall enable us to distinguish this carboniferous formation from the lower deposits. True, we recognize that its fossils are of distinct species, and that the Productus becomes more developed in size and number of species,* but Orthis and Spirifer are likewise present in forms very similar to those of the Devonian system or Chemung group. I repeat that this portion of the great Palæozoic series, is no better distinguished by its organic forms than are subordinate groups of the great series embraced within the state of New York.

* The genus Productus as distinguished from Chonetes and Leptæna, makes its first unequivocal appearance in the Onondaga and corniferous limestones, continuing through the Hamilton and Chemung groups, becoming even abundant near the close of the latter period.

† Mr. Vanuxem has compared this rock to the sandstone with Pentamerus of the greifenstein, (Duchy of Nassau.) If this is correct, the Oriskany sandstone belongs to the upper Silurian system, the Pentameri of the greifenstein being very similar to the *P. Knightii*.

‡ The Ludlow stage is also difficult to be recognized on the continent of Europe.

to prove that the old red sandstone in America is more recent than the schists and the limestones which represent the deposits of the Eifel, the Hartz, and of Devonshire.

The different groups of the Palæozoic formation of America, which we unite in the Devonian system of Europe, have with this a great number of identical fossils. We have recognized the following species: *Holoptychus nobilissimus*, teeth of *Dendrodus*, *Asterolepis*, *Phacops macropthalmus*, *Cryphæus calliteles*, *Goniatites retrorsus*, *Bellerophon striatus*, *Murchisonia bilineata*, *Chemnitzia nexilis*, *Avicula Damnoniensis*, *Pterinea fasciculata*, *Modiola squammifera*, *Inoceramus chemungensis*, *Cardium loricatum*, *Lucina proavia*, *L. rugosa*, *Grammysia hamiltonensis*, *Sanguinolaria dorsata*, *Terebratula cuboides*, *T. reticularis and aspera*, *T. concentrica*, *Spirifer mucronatus*, *S. macropterus*, *S. cultrijugatus*, *S. heteroclitus*, *S. Verneuili*, *Orthis striatula*, *O. umbonata*, *O. crenistria*, *Leptæna depressa*, *L. Dutertrii*, *L. laticosta*, *Chonetes nana*, *Productus subaculeatus*, *Favosites gothlandica*, *Porites interstincta*, *Stromatopora concentrica*, *Pleurodyctium problematicum*.

The common characters which unite the Devonian fauna of America and Europe, are the appearance of those great ganoid fishes of which the skin was composed of solid plates with shagreened surfaces, and that of the genera Goniatites, Nautilus, Pentremites and Productus, which have not to this time been authentically recognized in Silurian deposites. The greater part of the species which we have enumerated are found in the limestones of Devonshire, of Brittany and the Eifel, some others in the schists which are inferior to them and connected with them; thus the *Asterolepis*, *Phacops macropthalmus*, *Bellerophon striatus*, *Murchisonia bilineata*, *Chemnitzia nexilis*, *Inoceramus chemungensis*, *Cardium loricatum*, *Lucina proavia*, *L. rugosa*, *Sanguinolaria dorsata*, *Terebratula cuboides*, *T. reticularis and aspera*, *T. concentrica*, *Spirifer cultrijugatus*, *S. heteroclitus*, *S. Verneuili*, *Orthis striatula*, *O. crenistria*, *Leptæna depressa*, *L. Dutertrii*, *Stromatopora concentrica*, are found in the Devonian limestones of the Eifel, of Belgium and Boulonnais; the *Goniatites retrorsus* in those of Nassau; the *Cryphæus calliteles*, *Orthis umbonata*, *Leptæna laticosta*, at Gahard in Brittany. The *Chonetes nana*, in the Devonian system of Russia; in fine, the *Grammysia hamiltonensis*, *Pterinea fasciculata*, *Spirifer macropterus* and *Pleurodyctium problematicum*, belong to the schists and graywackes of the borders of the Rhine.*

The Devonian system occupies in the state of New York, a more considerable area than the Silurian system. As it is prin-

* The presence of these species furnishes an argument in favor of the opinion of Mr. Römer, who considers these schists as belonging also to the Devonian system.

cipally composed of schists and argillaceous sandstones, which as we have said, are lost and disappear in the west, it thence results that in the states of Ohio, Indiana and Kentucky, it is reduced to the black schists, which represent the Genesee slate, and to a calcareous band which represents at once the corniferous and Onondaga limestones and the Hamilton group of the state of New York. In fine, it disappears entirely on the borders of the Mississippi, where the carboniferous system appears to repose directly upon the superior beds of the Silurian system.

(To be continued.)

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ART. XLI.—*Note respecting Halley's Comet;* by Professor LOOMIS, of New York University.

SIR JOHN HERSCHEL, in his recently published volume, containing the results of his Astronomical Observations at the Cape of Good Hope, has given a series of observations of Halley's comet, and has drawn from them some very remarkable conclusions. After its perihelion passage, he first observed the comet on the morning of Jan. 26th, 1836. With his twenty-feet reflector he saw a nucleus, vividly luminous, encircled with a strong coma which nearly filled the field of view, (fifteen minutes in diameter,) dying away insensibly but rapidly at the edges. Within the coma, was seen a well defined parabolic envelope, about four minutes in diameter. The next day, the diameter of this envelope was more than five minutes, and on the following days it increased with great rapidity. By comparing the rate of increase on successive nights, he inferred that on the 21st of January, the envelope *had no magnitude;* and that previous to that instant, the comet must have consisted of a mere nucleus, more or less bright, and a coma more or less dense and extensive.

In confirmation of this remarkable conclusion, it is stated that "Prof. Boguslawski of Breslau, on the night of the 22d of January, actually observed the comet *as a star* of the sixth magnitude, a bright concentrated point which shewed no disc with a magnifying power of 140."

As observations of the comet during the early part of January, appear to have been quite rare, I have thought that the few memoranda which I made on that occasion might be worth transcribing. The comet was distinctly seen at New Haven, by Professor Olmsted and myself, on the morning of December 31st, with the Clark telescope (a refracting telescope of ten feet focal length by Dollond); but we had not sufficient time for an accurate determination of its place. The following observations are extracted from my note-book.

"Thursday morning, Jan. 14, 1836, I saw the comet again. It was quite faint in the Clark telescope—not well defined—and fleecy in appearance. Comet no more obvious to the eye than it was Aug. 31st; perhaps not so much so. Moon four days from new, within 10° of the comet. The morning was pleasant, but somewhat hazy near the horizon.

"Jan. 15. Comet brighter than yesterday morning—quite distinct—decidedly brighter than Aug. 31st and larger, more irregular in outline—comet at least three minutes in diameter. Very clear this morning—atmosphere quite transparent."

On each of the preceding mornings, a diagram was made of the comet and two conspicuous stars in the same field of view; and as the same stars were seen on both mornings, while the comet had changed its position with respect to them nearly half a degree, there was no room for doubt respecting the nature of the object observed.

"Jan. 16th. Comet observed this morning with a small equatorially mounted telescope of eighteen inches focus—distinctly seen—though of feeble light, and outline quite ragged—fleecy.

"Jan. 26. Comet quite bright this morning in the equatorial (eighteen-inch focus)—no appearance of a nucleus—very ill defined.

"Jan. 29. Prof. Olmsted saw the comet distinctly with his naked eye—he looked at it with the telescope, and assured himself that it was indeed the comet. There was no star in the neighborhood with which it could be mistaken."

How can we reconcile the preceding observations with the statement of Prof. Boguslawski, that on the 22d of January he observed the comet as a star of the sixth magnitude, which showed no disc with a magnifying power of 140? That the parabolic envelope seen a few days later by Sir John Herschel did not exist on the 22d of January, is quite credible; but that there was then no irregular coma of considerable extent, such as was figured by Sir J. Herschel, Jan. 25th, and such as I certainly saw on the 14th, 15th and 16th, seems difficult to believe. Is it possible that Prof. Boguslawski mistook a *fixed star* for the comet? It is stated by Sir J. Herschel that "Prof. B. assured himself that it actually *was* the comet and no star, by turning the telescope the next night on the place where he saw it. *It was gone.*" Prof. B. does not state that he found the comet at all on the 23d of January, and the preceding language might be construed as implying that he did not. If such were the case, would not this circumstance afford a presumption that he had mistaken his object the preceding night?—for it is difficult to suppose that the comet had vanished entirely on the 23d of January. The comet must have been difficult to observe at Breslau, being only 10°

above the horizon when on the meridian, and the comet did not come upon the meridian until about *sunrise.*

Is it possible that when Prof. B. describes the comet as seen "without the slightest diameter," he refers simply to the parabolic envelope subsequently observed, and does not mean to deny the existence of an irregular coma of great extent? If so, then his observation appears quite consistent with other established facts, although we should regard the language he has employed peculiarly unfortunate. On the whole it appears very desirable that further observations made during the month of January, 1836, should be rescued from oblivion; and we are impressed with the importance of the observatories recently erected in the United States, where observations can frequently be made such as are impracticable at the more northern observatories of Europe.

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ART. XLII.—*A Determination of the General Law according to which Pulses differing in intensity are propagated in Elastic Media, with remarks on the received Theory of the Velocity of Sound;* by ELI W. BLAKE.

SIR ISAAC NEWTON, in his Principia, Book II, prop. 47, 48, 49, has determined the velocity of a pulse, propagated in the atmosphere, whose intensity differs from cipher only by a very small quantity; or rather, as we shall see in the course of this article, whose intensity is cipher. This velocity he shows to be that which a body would acquire by falling over half the atmospherical subtangent; and this he assumes would be the velocity of sound, provided the atmosphere were perfectly pure and perfectly elastic. Lagrange and others have since investigated the same case by different processes, but with the same result, and have concurred with Newton in regarding that result as showing the true theoretical velocity of sound. Both Newton and Lagrange in their respective solutions of the case assume, in effect, that the velocity of the pulse is irrespective of its intensity. Newton at one point, (prop. 48, case 1,) appears to recognize the fact that an increased intensity would make a difference, but thinks that unless the pulse were "exceedingly intense," the error would not be sensible. But Lagrange says, (Mecanique Analytique, Part II, sec. 12, art. 14,) "the velocity of the pulse is constant and independent of the primitive movement, which is confirmed by experience, as all sounds (*forts ou foibles*) appear to be propagated with the same velocity."

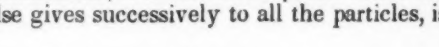
It is proposed in this article to show that the velocities of pulses vary with their intensities, and to determine, in general form, the relation which subsists between the velocity and intensity of

pulses. This we shall do by solving the general problem of the velocity of pulses by a new process, which comprehends the intensity of the pulse as an essential element. Having done this, we shall see the relation in which the case solved by Newton stands to the general law; and if we mistake not, it will then be apparent that the velocity found in that case is not the velocity of sound.

A pulse, considered as propagated through a line of particles and considered with reference to its physical condition at any instant of time, consists of a series of contiguous particles in that line, greater or less in number, which are more dense than the particles before and behind them on the line, and which are in motion with some velocity, while the particles before and behind are at rest and in their natural state of density. This series of particles, as it advances, encounters successively the stationary particles, compressing them to the same density, putting them in motion, and thus adds them to the series. In the mean time, an equal number of the posterior particles of the series expand, resuming their natural density, and come to rest. It is obvious that if the propelling force due to the reaction of the particles expanding from the posterior extremity of the series, is equal to the retarding force of the particles encountered by the anterior extremity, (as must always be the case if the elasticity is perfect, and if the action is confined to the particles in the line,) then the pulse will continue to advance indefinitely, and with a uniform velocity; a velocity however which, as we shall see, is not independent of the degree of condensation to which the particles are brought.

Let C be a point where the density is a maximum in a pulse which is moving toward B. It is not material to our present purpose to inquire whether the place of maximum density is a mere point, or whether it extends over some finite space on the line AB. In either case, some where in advance of C we shall find particles in every stage of density from the natural to the maximum state; and these will be arranged in the order of their density, the more dense being toward C. Each of these particles will be accelerated so long as the density of the particle behind it is greater than that of the particle before it, and no longer. Consequently each will have its maximum velocity when it reaches its maximum density. Therefore if C is a point where the density is a maximum, it is likewise a point where the velocity, which the pulse gives successively to all the particles, is a maximum.

Let *mn* be the space which a particle in its natural state occupies on the line AB, and let *sn* be that which it occupies in its most condensed state. Let D be



a point in the line AB, in advance of C, where the particles are at rest, not having yet felt the influence of the approaching pulse; and let the two imaginary points C and D be conceived to move with the same velocity as the pulse. Then each travels *over* the same space and *through* the same number of particles in a given time. Consequently while C moves over a space equal to that occupied by a particle in its natural state, it only moves *through* one particle in its most condensed state; that is to say, while C moves over the space $mn$, it moves, relatively to the particle through which it passes, only over $sn$. Consequently the particle itself moves in the same time over a space equal to $ms$. Hence when $mn$ represents the velocity of the pulse, $ms$ represents the final velocity which the pulse gives to every particle through which it passes.

Let H be the atmospherical subtangent; or the length of the column of particles of the natural density whose weight is equal to the elastic force of a particle in its natural state, and let $H+h$ be the length of a similar column whose weight is equal to the elastic force of a particle at the maximum density.—Since the space occupied by a particle is inversely as the compressing force, we have,

$$mn : sn :: H+h : H \text{ or } ms+sn : sn :: H+h : H;$$

consequently $ms : sn :: h : H$. Whence $H=\frac{sn \times h}{ms}$

The force which accelerates all the particles in advance of C, which have felt the influence of the pulse but have not yet reached their maximum velocity, is the difference of the elastic forces which correspond to the natural and the maximum densities. This is a constant force, and must evidently be that force which is competent to give the velocity $ms$ to all the particles in any space in the time in which the pulse runs over that space. Let us suppose the pulse runs over the space $h$. Then the pulse runs over $h$ in the time in which the difference of those elastic forces will give to all the particles in $h$ the velocity $ms$. But the difference of the elastic forces is equal to the weight of all the particles in $h$. Therefore the pulse runs over $h$ in the time in which those particles would in falling by their own weight acquire the velocity $ms$.

The time in which a falling body acquires the velocity $ms$ is to the time in which it would acquire the velocity of the pulse or $mn$, as $ms$ to $mn$, and the spaces over which the pulse would run in these times are as the times and therefore as $ms$ to $mn$. Therefore putting S for the space which the pulse would run over while a falling body would acquire the velocity of the pulse, we have $ms : mn :: h : S$. Whence

$$S=\frac{mn \times h}{ms}=\frac{\overline{ms+sn} \times h}{ms}=\frac{sn \times h}{ms}+h.$$

But we have before found $H=\frac{s\,n\times h}{m\,s}$. Substituting H for its value in the preceding equation, we have $S=H+h$. If then we put $H+h$ for the velocity of the pulse, the space through which a body must fall to acquire that velocity will be $\frac{H+h}{2}$.

In this expression $h$ is to be regarded as the *intensity* of the pulse: it being the length of that column of particles which must be superadded to the height of a homogeneous atmosphere, in order to produce in the air that degree of increased condensation which the pulse effects in the particles through which it passes.

If in the expression last found we make $h=0$, the expression becomes $\frac{H}{2}$. This is the result arrived at by Newton and which, as we have already remarked, was regarded by him and is now generally received as the theoretical formula for the space through which a body must fall to acquire the velocity of sound. But it is evident from our demonstration that the velocity due to that space, instead of being the velocity of any assignable pulse, is simply a limit below which no pulse can be propagated in an elastic fluid whose subtangent is H.*

A pulse which produces the sensation of sound must produce real motion in the particles through which it passes. In such a pulse $h$ must have some finite magnitude. Nor can that magnitude be by any means the smallest that is competent to produce motion in the air; for if such were the fact, then the slightest impulse given to the air by a vibratory movement, even waving the hand in it, should produce the sensation of sound. The intensity of a pulse which is competent to produce that sensation, will of course vary with the sensibility of the ear which is to receive it; and consequently the nature of the case does not allow us to assign any definite magnitude to the minimum intensity of sonorous pulses; but we know by experience that the velocity of

* Newton's demonstration of this problem has been regarded by several distinguished mathematicians as obscure and inconclusive. It commences with the hypothesis that a particle put in motion by a pulse is accelerated and retarded according to the law of the oscillating pendulum. Gabriel Cramer (see Glasgow edition of Newton's Principia, Book II, prop. 48, notes) objects to the result arrived at by Newton, that it flows from his hypothesis and not from the nature of things. To prove this he deduces the same result upon the hypothesis that the particle is accelerated and retarded by a constant force. The fact that Cramer's hypothesis answered just as well for the solution of the problem as Newton's, seems not a little to have puzzled the editor of the edition of the Principia referred to, who devotes several pages of notes to the vindication of Newton's result from its supposed bearing. But the enigma is solved when we consider that both Newton and Cramer regard the space through which the particle vibrates as an infinitesimal quantity. In such case, evidently it can make no difference what is assumed as the law of acceleration; this being a point at which all laws coalesce.

the particles in which a pulse originates must be great in order to produce the sensation of sound in the most delicate ear. We also know that in the case of the heavier sounds, as the report of cannon, the condensation of the particles in which the pulse originates is very intense.

This view of the subject may throw some light upon the discrepancy between the theoretical velocity of sound, as determined by Newton and others, and its real velocity as found by experiment. The velocity according to that theory should be about 944 feet in a second; varying slightly from this according to the state of the barometer, thermometer, and hygrometer.

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|---|---|---|
| The velocities found by experiment, by | Roberts, | 1300 |
| | Boyle, | 1200 |
| | Mersenne, | 1474 |
| | Flamsteed and Halley, | 1142 |
| | Florentine Academy, | 1148 |
| | French Academy, | 1172 |

Newton adopts the smallest of these experimental velocities, viz. 1142 feet per second, as the true practical velocity of sound; and to this he reconciles his theory; in part, by a hypothesis that the air consists, to a certain extent, of solid particles, through which the pulse is transmitted instantaneously; and in part by another hypothesis, that the pulse does not give motion to the foreign matter which the air contains, and so is transmitted so much the faster through the true air as there is less of it in a given space. This explanation of the matter has not been satisfactory to those who have followed Newton in investigating this subject. They have justly thought that such causes might retard, but could not accelerate the pulse. Various other hypotheses have been successively proposed and rejected, and a vast amount of labor has been expended in the effort to reconcile theory and practice in this case. Of these hypotheses, we will mention only that which Laplace is said to have regarded as the true one, viz., the increased elasticity in the air produced by the heat evolved by condensation. A little reflection will serve to show that this cause also may retard but cannot accelerate the pulse. In order that the force of the pulse may be maintained without loss, the propelling force derived from the reëxpansion of the particles must be not less than their retarding force in being compressed; and in order to this, whatever heat is evolved during their compression, must be reabsorbed in their reëxpansion. If then any *time* is required either for the evolution of the heat, or for its reabsorption, so that the specific heat of the particle does not instantaneously conform to the change of density; or if any portion of the heat evolved is radiated and lost, so as not to be present to be reabsorbed, then the evolution of heat must retard the pulse. Otherwise it cannot affect the velocity of its propagation.

In the view of the subject we have taken, it will cease to be a matter of surprise that the velocity of sound should be found to be greater than that assigned by Newton's theory; as also, that the experimental velocities should be found to differ greatly among themselves, however carefully the experiments may have been tried.

When the velocity of a pulse is given, we may find its intensity by the formula, $h = \frac{V^2}{32} - H$. We may find the maximum density, the natural density being 1, by the formula, max. dens. $= \frac{V^2}{32H}$. We may find the space occupied by a particle at the maximum density, its natural extent being 1, by the formula, extent at max. dens. $= \frac{32H}{V^2}$.

When the velocity is 1142 feet per second, if we put the subtangent H = 27818 feet, we have

Intensity of the pulse, $h = 12937$ feet.

Maximum density, 1·465.

Extent of particle, 0·682.

If we take for the given velocity, that which a body would acquire by falling through the subtangent, or that with which air would rush into a vacuum, we shall find $h = H$, and the particles will be compressed into half their natural size, and the density will be double the natural density.

A condensing force equivalent to the pressure of a column 12937 feet high, and which compresses the particles into about $\frac{6}{1000}$ of their natural size, is a pulse "exceedingly intense" as compared with that which Newton supposes; but if our solution of the problem is correct, it is physically impossible that a pulse of less intensity should propagate itself in our atmosphere with a velocity of 1142 feet in a second.

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ART. XLIII.—*Review of a Manual of the Botany of the Northern United States, by Asa Gray, M.D., Fisher Professor of Natural History in Harvard University.**

THE opportunities for the study of botany are so great in this land of virgin forests, and wide uncultivated fields, that it has become with us a favorite amusement as well as source of knowledge; and through our many schools, its votaries are rapidly multiplying. There are great numbers that hail the season of spring with special pleasure, because they may renew their ac-

* For the full title, see page 297 of this volume.

quaintance with the many wild flowers in their native haunts; and still larger numbers that look forward with delight to the commencement of their botanical studies.

To all who are interested in the science, we recommend strongly this volume by Professor Gray. It is just the companion needed for a walk in the woods;—convenient in size—excellent in arrangement—clear in typography,—and what is especially important, it comes from a master in the science, well known to the country and to science abroad by his former botanical works. Professor Gray has been occupied for many years with the special study of American botany. He has traversed the land north and south, in order to acquire that critical knowledge which was demanded for his contemplated works. In connection with Prof. Torrey, who had led the way in the science and still stands preëminent, he commenced a general treatise on the botany of our country, to contain a full and complete exposition of the characters and synonymy of our plants. The preparation of such a work is beset with difficulties, arising from the bad descriptions of previous authors, or descriptions from imperfect specimens, and still more from the ignorance which had confounded plants that were distinct, and renamed those already described. While in the midst of these labors, Prof. Gray in 1839, soon after the publication of the first number of this work, visited Europe, for the purpose of examining the herbariums of Linnæus, Catesby, Pursh, Michaux, Jussieu, De Candolle, and others,* in which North American plants were to be found with the labels as written by the authors who first described them. Appealing thus to the source of knowledge, he became furnished with a vast amount of critical information, and returned to apply it in the farther prosecution of the great undertaking alluded to. For the preparation of the smaller volume just issued, he has been drawn aside from the larger work, in order to promote the interests of a favorite science, as well as the benefit and pleasure of all lovers of flowers. Both of these objects we are confident will be fully accomplished. A book from such a source must be a good and faithful one.

It is often assumed that superficial knowledge will make a book good enough to instruct youth; and many of the popular school-books of the day, especially those touching upon science, are painful exhibitions of ignorance—mixtures of ill assorted truth and error—multiplying greatly the difficulties and trials of the learner. But in fact, the most extended knowledge is required to reduce the full treatise to a simplified and well digested abstract, which shall be at the same time intelligible to the young learner and true to the science. This difficulty is more strongly appreciated by the adept than by the half learned mind. It is no

* See this Journal, vol. xl, p. 1, 1841.

uncommon thing for a single book-making genius to grasp (or grasp at) the whole range of sciences. With more modesty, Prof. Gray, in making this small manual, in a department that has occupied many years of research, ventured himself upon a portion only of the field. He was indebted to JOHN CAREY, Esq., for the sections on the *Willows*, *Poplars*, and the large group of grasses, constituting the genus *Carex*, with which Mr. Carey was especially conversant; moreover, Mr. WM. S. SULLIVANT took the entire charge of the Mosses and Liverworts, and Mr. E. TUCKERMAN, that of the Lichens. Here then, in the writing of a common school-book, we have the combined labors of three accomplished botanists in addition to the author, besides also farther aid from others, whose assistance is fully acknowledged in the preface. The chapter on the Lichens has been omitted in this edition on account of the size of the volume, but is promised in connection with a second edition.

The work commences with an introduction on the outlines of botany. The structure of a plant and the nature and uses of its parts are briefly but perspicuously explained, and definitions are given of the various terms employed. This introduction is not a mere glossary, although possessing the advantages of one, especially in connection with an alphabetized list of terms following. The idea of a plant as a living object having powers of growth and development, as well as leaves and flowers, was evidently in the mind of the able writer, and as such it is presented to the reader.

The introduction covers about fifty pages. The rest of the volume is occupied with the description of genera and species. The limits and general scope of the work have been already presented by us on page 298, in citations from the preface.

The arrangement adopted is the Natural Classification, or that based upon the natural relations of the species. The only advantage claimed for the Linnæan Artificial arrangement is, its facilitating the determination of the name of a plant. This end is fully secured in the work, by the introduction of a detailed synopsis of this arrangement, with brief characteristics of genera, by means of which the learner is guided to the genus, if his knowledge of the science is not sufficient to enable him to employ the other method; and a reference to the page is annexed, where the genus is afterwards taken up. The work therefore combines the advantages of both systems. Like some earlier works, the artificial system is thus presented as a means of ascertaining the genus; and then instead of looking for the genus with its species in an unmeaning alphabetical list, the reader is referred to its natural family where he finds it associated with the genera and species to which it is allied. There is also an analytical Key to the Natural Orders, which after a little experience the stu-

dent will find far preferable to the old Linnæan system, even for arriving at the name of a species.

The descriptive part of the work, which occupies 700 pages, bears the impress, as already intimated, of a vast deal of original research. At the same time all unnecessary abstruseness has been studiously avoided. As far as is consistent with brevity and perspicuity, the descriptions are drawn up in simple untechnical English, and special effort has thus been made to remove impediments in the way of the learner. This liberty with the precise language of science, a hazardous trust in the hands of the unskilled, is used with great caution and good judgment. The characters moreover are given with fullness. They are not, as in most compendiums, confined to a few dry terms hardly sufficient for the adept, but are drawn out with some detail; and the well selected observations which follow, indicate an observer familiar with the objects he describes, often bringing the plant like a picture before the mind of the learner.

To render the work still more convenient for use, the names of the genera and species are printed in a broad faced type, and are thus made to stand out prominent on the page. Moreover the accentuation is indicated, and also the etymology of the generic names. No pains have evidently been spared, to render the work serviceable to the science and the learner.

We observe that some old familiar names of genera are changed, and these new titles to old plants may seem at first unnecessary innovations, adding new difficulties to the science. They are not difficulties to the young learner, who has no knowledge to unlearn. And by the scientific botanist they are required, whatever the inconvenience, provided the changes are only corrections of former errors, or a recognition of an earlier and neglected name. We do not pretend ourselves to judge in all the particular cases, as this demands careful research. But, after the exposition of Prof. Gray's views on changes in nomenclature, in this Journal, vol. iii, for 1847, p. 304 and beyond, we have good reason to place implicit reliance upon his decisions. Progress implies change, and an unyielding nomenclature is one of the greatest obstacles to the advance of scientific truth.

The manual is from its nature a book of reference. The subjects of structure and physiology, which are briefly presented in the Introductory Chapter, are treated of at length in a previous work by our author, entitled the Botanical Text-Book, the second edition of which appeared in 1845. The whole process of growth with its various phases of development, the nature of a plant, and the peculiar structures exemplified in the different orders, are here brought out in a popular yet scientific style, with numerous illustrations. This former treatise is full of interesting detail, and is a valuable and appropriate introduction to the Manual.

ART. XLIV.—*Upon a peculiar kind of Isomorphism that plays an important part in the Mineral Kingdom;* by Professor SCHEERER of Christiania.*

WHAT first led me to the discovery of the kind of isomorphism, the nature and frequent occurrence of which in the mineral kingdom it is purposed to enter upon in the present paper, was the examination of two minerals. One of these substances is a mineral already known, namely, *Cordierite;* the other, on the contrary, is a new mineral species, to which I have given the name *Aspasiolite.* I will at the outset detail my observations upon both these minerals, and then proceed to enter upon the inferences drawn therefrom.

1. *Cordierite.*—The cordierite that formed the subject of my investigations is met with in the vicinity of Krageröe, a sea town in the south of Norway, about eighteen English miles northeast of Tvedestrand, a town on the same coast and the well known locality of the beautiful blue cordierite, red garnet and crystallized titaniferous iron. The cordierite of Krageröe is not remarkable for anything like so deep a blue color as that of Tvedestrand; it is, generally speaking, of a pale amethystine tint or quite colorless, by which it assumes very much the appearance of common greasy quartz.

It is by no means an easy matter, owing to the considerable amount of alumina and magnesia that are contained in cordierite, to arrive at a correct analysis of the mineral. The separation of these earths by caustic potash or (when a considerable quantity of ammoniacal salts is contained in the solution) by caustic ammonia, is, as we are aware, only applicable when one of the earths in question is present in a comparatively small quantity. I therefore had recourse to another method, to which M. Henry Rose, in his work on analytical chemistry, gives the preference in cases where considerable quantities of these earths are to be separated. I put a considerable quantity of the solution of bicarbonate of soda required for the process in question into a large flask, and then added thereto, drop by drop, the acid solution containing the alumina, the magnesia, and the trifling portion of oxyd of iron of the cordierite. The bulk of this acid solution was at least fifty times less than that of the alkaline solution in the flask, and this latter was gently shaken as each drop of the acid solution was let fall into it. By this means the separation of these earths promised, I thought, to be more complete than when, on the contrary, the bicarbonate of soda is poured into the solu-

* From Poggendorff's Annalen, vol. lxviii, p. 319; translated for this Journal by Mr. W. G. LETTSOM.

tion of the earths. I however found that the alumina thus precipitated was not free from magnesia. After separating it therefore by filtering and dissolving it in muriatic acid, it was treated again in a similar manner. But even now the alumina thrown down was not entirely free from magnesia, as was subsequently shown when it was treated with caustic potash, by which operation there was left undissolved a substance consisting chiefly of oxyd of iron, from which minute quantities of alumina and magnesia were precipitated. The principal amount of the magnesia that was held in solution by the bicarbonate of soda, was separated with the necessary precautions by boiling and other methods, the slight quantity of the oxyd of iron present which had been taken up with the magnesia in the large excess of the alkaline solution, having been previously thrown down by a few drops of sulph-hydrate of ammonia. This sulphuret of iron was not altogether free from traces of magnesia.

From two analyses of the Krageröe cordierite, in which the separation of the alumina and magnesia was performed as here described, the following results were obtained:

| | I. | II. | Mean. |
|---|---|---|---|
| Silica, . . . | 50·44 | 50·44 | 50·44 |
| Alumina, . . | 33·22 | 32·68 | 32·95 |
| Magnesia, . . | 12·43 | 13·08 | 12·76 |
| Lime, . . . | 1·08 | 1·17 | 1·12 |
| Protoxyd of iron, . | 0·79 | 1·12 | 0·96 |
| Protoxyd of manganese, | trace. | trace. | trace. |
| Water, . . . | 1·17 | 0·87 | 1·02 |
| | 99·13 | 99·36 | 99·25 |

The amount of silica could be determined in only one of these experiments, inasmuch as in one analysis the mineral was not fused with carbonate of soda but was attacked with fluoric acid.* The ratio of the oxygen of the silica to that of alumina and to that of the 1 : 1 atomic bases is consequently as follows:

$$\dddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathrm{l} \quad \dot{\mathrm{R}}$$
$$26{\cdot}20 : 15{\cdot}26 : 5{\cdot}48,$$

assuming the small amount of iron in the mineral to be in the form of the protoxyd. This, however, can scarcely be the case with the cordierite here the subject of analysis, which was almost entirely colorless, and did not show the slightest tinge of green, whereas it is well known that, comparatively speaking, very

* Plattner's apparatus was had recourse to for this fusion. The mass was not completely fused, but was rendered *thoroughly* attackable by hydrochloric acid. Frequent experience has convinced me of the great advantages which this apparatus offers to the mineralogical chemist whose time and trouble are materially saved thereby.

minute quantities of the protoxyd of iron are sufficient for imparting to a silicate (when not in a pulverulent form) a decided green tinge, if not interfered with by the presence of other coloring substances. Assuming, therefore, and we are doubtless better borne out in doing so, that the iron is in the condition of a peroxyd, the ratio of the oxygen becomes

$$\ddot{\mathrm{Si}} \quad \ddot{\mathbf{R}} \quad \dot{\mathrm{R}}$$
$$26{\cdot}20 : 15{\cdot}64 : 5{\cdot}26,$$

agreeing very closely with the formula $\dot{\mathrm{R}}^3\,\ddot{\mathrm{Si}}^2 + 3\ddot{\mathbf{R}}\,\ddot{\mathrm{Si}}$, which would require a ratio of 26·20 : 15·72 : 5·24. The formula cited above is however that of the so-called hard fahlunite, whereas that of cordierite, according to Berzelius, has been hitherto held to be $3\dot{\mathrm{R}}^3\,\ddot{\mathrm{Si}}^2 + 8\ddot{\mathbf{A}}\mathrm{l}\,\ddot{\mathrm{Si}}$.* The ratio of the oxygen agreeing with this last formula, is

$$\ddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathrm{l} \quad \dot{\mathrm{R}}$$
$$26{\cdot}20 : 14{\cdot}97 : 5{\cdot}62,$$

and is therefore an approximation to the first that was obtained, in which the iron in the Krageröe cordierite was held to be in the state of a protoxyd. As it does not however appear to me that this assumption is fairly borne out, I here give the preference to the more simple formula $\dot{\mathrm{R}}^3\,\ddot{\mathrm{Si}}^2 + 3\ddot{\mathbf{R}}\,\ddot{\mathrm{Si}}$.

This leaves us to consider whether the constitution of cordierite from other localities may not be also expressed by this simpler formula. The ratio of the oxygen is, however,

| | | | | | |
|---|---|---|---|---|---|
| 1. | In the Cordierite from | Bodenmais, | according to | Stromeyer, | 25·12 : 14·81 : 5·90 |
| 2. | " | Simiutak, | " | " | 25·51 : 15·47 : 5·43 |
| 3. | " | Orijerfvi, | " | " | 25·22 : 14·82 : 5·83 |
| 4. | " | " | " | von Bonsdorff, | 25·95 : 15·36 : 5·18 |
| 5. | " | " | " | Thomson, | 25·21 : 14·71 : 6·23 |
| 6. | " | Connecticut, | " | " | 25·78 : 13·41 : 6·39 |

The mean of these six analyses gives

$$\ddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathrm{l} \quad \dot{\mathrm{R}}$$
$$25{\cdot}47 : 14{\cdot}76 : 5{\cdot}83,$$

whereas, according to the formula $\dot{\mathrm{R}}^3\,\ddot{\mathrm{Si}}^2 + 3\ddot{\mathbf{A}}\mathrm{l}\,\ddot{\mathrm{Si}}$, it should be 25·47 : 15·27 : 5·09. On the assumption, however, that, in these cordierites too, a small portion of the iron exists in the form of a protoxyd, the average ratio is convertible to

$$\ddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathrm{l} \quad \dot{\mathrm{R}}$$
$$25{\cdot}47 : 15{\cdot}27 : 5{\cdot}37,$$

which agrees so closely with the formula $\dot{\mathrm{R}}^3\,\ddot{\mathrm{Si}}^3 + 3\ddot{\mathbf{R}}\,\ddot{\mathrm{Si}}$, that I

* Or, more fully, $\mathrm{Fe}^3\,\ddot{\mathrm{Si}}^2 + 2\ddot{\mathbf{A}}\mathrm{l}\,\ddot{\mathrm{Si}} + 2\,[\mathrm{Mg}^3\,\ddot{\mathrm{Si}}^2 + 3\ddot{\mathbf{A}}\mathrm{l}\,\ddot{\mathrm{Si}}]$.

cannot but look on this simpler expression as the true representative of all cordierites.

Be this however as it may, it noways influences the deductions which, as will be seen below, we draw from the composition of the mineral in question, and the other formula may, with equal propriety, be looked upon as the correct one. It, nevertheless, struck me that the agreement of the formula of cordierite with that of the closely allied hard fahlunite, was a point of sufficient interest to justify these passing remarks.

2. *Aspasiolite.*—In most of its mineralogical characters, especially in color, lustre, translucency and hardness, this substance, which occurs at the same locality as the cordierite just described, agrees very closely with serpentine.* It is usually of a green color of various shades, mostly light, such as leek-green, asparagus-green, oil-green, &c. Here and there the mineral exhibits portions of a brown or reddish-brown color, which appears to me to be owing to an intermixture of oxyd of iron. The specific gravity of aspasiolite is somewhat higher than that of serpentine, namely, 2·764 (after drying in the water-bath and boiling in water). Perfectly pure portions of the mineral are but little harder than calc spar. In the various specimens that I possess of this substance it occurs associated with cordierite, quartz, feldspar and mica, (and now and then with titaniferous iron,) and this mineral admixture is met with in the primary gneiss of Krageröe, a formation remarkable for various magnesian minerals. As far as my present experience goes, it is but seldom met with crystallized. I am in possession of two fragments of distinct crystals of a considerable size, the diameter of one being about three-quarters of an inch; what the size of the other crystal was, it is not so easy to say exactly, owing to a piece being missed; it must, however, have been of a larger size than the former one. The form of the crystals will be mentioned in the sequel, as will also a peculiarity connected therewith.

Before the blowpipe, aspasiolite shows no distinctive characters. It is infusible, gives off water in the tube, and gives, when treated with salt of phosphorus and borax, the reaction of silica and iron. A preliminary qualitative examination shows it to consist chiefly of silica, alumina, magnesia, protoxyd of iron and water. Two analyses in which I separated the magnesia from the alumina as I have described above, and attached the mineral in a state of minute subdivision with boiling hydrochloric acid, gave me the following results:

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* I received both substances from Messrs. Dahl and Weibye of Krageröe, mineralogical students at this University, to whose kindness I am already indebted for several interesting minerals.

| | I. | II. | Mean. |
|---|---|---|---|
| Silica, . . . | 50·29 | 50·51 | 50·40 |
| Alumina, . . | 32·40 | 32·35 | 32·38 |
| Magnesia, . . | 8·04 | 7·97 | 8·01 |
| Lime, . . . | trace. | trace. | trace. |
| Protoxyd of iron, . | 2·30 | 2·39 | 2·34 |
| Protoxyd of manganese, | trace. | trace. | trace. |
| Water, . . . | 6·58 | 6·88 | 6·73 |
| | 99·61 | 100·10 | 99·86 |

The corresponding ratio of oxygen as deduced from the mean of those two analyses, is

$$\ddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathbf{l} \quad \dot{\mathrm{R}} \quad \dot{\mathbf{H}}$$
$$26{\cdot}18 : 15{\cdot}12 : 3{\cdot}63 : 5{\cdot}98.$$

On endeavoring to deduce from this a formula for aspasiolite by the usual methods, we do not arrive at anything like a satisfactory result. Even when small deviations are allowed from the proportions here obtained, we obtain expressions that are scarcely probable and noways in harmony with the formula of cordierite, though nevertheless, as will be immediately seen, both minerals, owing to the circumstances of their occurring together, stand in very close relation to each other.

On comparing the composition of aspasiolite with that of the cordierite of Krageröe, we see that the silica and alumina occur in nearly the same quantities in both substances, and that it is principally in the diminished amount of magnesia, consequent upon the considerable amount of water, that the constitution of the former mineral differs from that of the latter. This circumstance, remarkable enough in itself, becomes of more importance when we reflect that *the two minerals are precisely of the same crystalline form*, namely, rhombic prisms of 120° with combinations of 0P, $\infty \breve{P} \infty$, and $\infty \dot{P} \infty$, that is to say, the ordinary crystalline form of cordierite. Even a closer connection between the two species is indicated by the circumstance, that not only *in one and the same specimen* the most perfect transition from one mineral to the other may be observed, but, first and foremost, from the crystals consisting *in part of aspasiolite and in part of cordierite*. The central portion of the crystals especially, is composed of the latter mineral, and passes into the other, as is shown not only by the different color of the two substances, but by their very different hardness, that is to say, that of quartz and calc spar. And that there is not the slightest reason to suppose that one of these substances is weathered or anything of that sort, is evident from the fact that the fresh and compact mass formed from the intimate admixture of two minerals in question, does not show any symptoms whatever of decomposition. None of the minerals that occur here, not even the mica or the feldspar, have lost anything of their lustre or of freshness in their fracture.

Under these circumstances the idea is forced upon us, that these two minerals, cordierite and aspasiolite, are *isomorphous*, and that this isomorphism is founded upon *the power which a certain amount of water has to replace a certain quantity of magnesia.* Calculation informs us that in this case, three equivalents of water would replace one equivalent of magnesia. Assuming this to be the case, and substituting magnesia* in accordance therewith for the amount of water contained in aspasiolite, we should obtain the following ratio of oxygen for this mineral,

$$\dddot{\mathrm{Si}} \quad \ddot{\mathbf{A}}\mathrm{l} \quad \dot{\mathrm{R}}$$
$$26{\cdot}18 : 15{\cdot}12 : 5{\cdot}63;$$

whereas the corresponding ratio for the Krageröe cordierite was, as has been shown, 26·20 : 15·26 : 5·48. Both these ratios of oxygen become, therefore, by this substitution, all but precisely similar. Even assuming that in aspasiolite a minute portion of its iron (about half its amount) occurs as the peroxyd, would modify the above ratio but very immaterially; in that case we should have the numbers,

$$\dddot{\mathrm{Si}} \quad \ddot{\mathbf{R}} \quad \dot{\mathrm{R}}$$
$$26{\cdot}18 : 15{\cdot}52 : 5{\cdot}37,$$

thus approximating to the ratio of oxygen that we arrive at in reckoning the minute quantity of iron in the Krageröe cordierite as a peroxyd, by which, as before stated, the numbers we obtain are, 26·20 : 15·64 : 5·26.

Whatever view we are disposed to adopt therefore, in this respect, the result in every case is, *that the similar crystalline forms in aspasiolite and in cordierite, is to be explained upon the assumption that three equivalents of water can replace isomorphically one equivalent of magnesia.* So striking a result as this, in the present want of any analogous observations, could not, it is self-evident, although borne out by facts, be at once looked upon as thoroughly established; and I therefore set about investigating the truth of the matter from other points of view, to the utmost in my power.†

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* That is to say, in the *proportion* of $3\dot{\mathrm{H}}$ to $1\dot{\mathrm{Mg}}$, or in other words of $3\times 112{\cdot}48 = 337{\cdot}44$ to 258·35; therefore for every *part by weight* of water, $\frac{258{\cdot}35}{337{\cdot}44} = 0{\cdot}766$ *part by weight* of magnesia. For the 6·73 per cent. of water contained in aspasiolite, according to my analysis, we must therefore substitute $6{\cdot}73\times 0{\cdot}766 = 5{\cdot}15$ per cent. of magnesia. In calculating the oxygen ratio it is not, as indeed may be directly inferred from what has been said, necessary first to work out such a substitution, and then to calculate the oxygen of the quantity of magnesia thus increased. All that is requisite is to divide the amount of the oxygen of the water by three, and to add the quotient thus obtained to the oxygen of the magnesia, by which means, in the example before us, the total amount of oxygen in $\dot{\mathrm{R}} = 3{\cdot}63 + \frac{1}{3}\times 5{\cdot}98 = 5{\cdot}63$, as we find it given above.

† Something bearing the greatest analogy to Prof. Scheerer's views has, unless I am altogether mistaken, been published. I allude to what Prof. Fuchs says relative to a certain quantity of water replacing soda.—W. G. L.

It was to be expected that this peculiar species of isomorphism would not manifest itself by one insulated fact, but that, as far at least as the mineral kingdom is concerned, it must play a more or less important and general part, and that further proofs of the justice of my views would in consequence be drawn from the composition of other hydrous minerals. My attention was in the first case directed to an examination of one of the most common hydrous silicates of magnesia, serpentine.

3. *Serpentines.*—The analysis of serpentines from different localities has led to results which, as shown by the following table, differ very materially.

| Serpentine from | | | $\dddot{Si}$ | Mg | Ca | Fe | Mn | $\dot{H}$ | Other constituents. |
|---|---|---|---|---|---|---|---|---|---|
| 1. Snarum, according to | | Hartwall, | 42·97 | 41·66 | . | 2·23 | . | 12·27 | 0·87 $\ddot{Al}$ |
| 2. Sala, | " | Lychnell, | 42·16 | 42·26 | . | 1·98 | . | 12·33 | 1·03 bitumen and $\ddot{C}$ |
| 3. Gullsjö, | " | Mosander, | 42·34 | 44·20 | . | . | . | 12·38 | 0·89 $\ddot{C}$ |
| 4. Snarum, | " | my analysis,* | 40·71 | 41·48 | . | 2·43 | . | 12·61 | 2·39 $\ddot{Al}$ |
| 5. New York, | " | Beck, | 41·00 | 41·26 | 2·39 | 1·85 | . | 13·50 | |
| 6. Fahlun, | " | Jordan, | 40·32 | 41·76 | . | 3·33 | . | 13·54 | |
| 7. Hoboken, | " | Lynchnell, | 41·67 | 41·25 | . | 1·48 | . | 13·80 | 1·37 bitumen and $\ddot{C}$ |
| 8. Fahlun, | " | Marchand, | 40·52 | 42·05 | . | 3·01 | . | 13·85 | 0·21 $\ddot{Al}$ |
| 9. Philippstadt, | " | Stromeyer, | 41·66 | 37·16 | . | 4·05 | 2·02 | 14·72 | |
| 10. ? | " | John, | 42·50 | 38·63 | 0·25 | 1·35 | 0·56 | 15·20 | 1·00 $\ddot{Al}$ |
| 11. Massachusetts, | " | Shepard, | 40·08 | 41·40 | . | 2·70 | . | 15·67 | |
| 12. Bare Hills, | " | Vanuxem, | 42·69 | 40·00 | . | 1·16 | . | 16·11 | 0·87 $\ddot{C}$ |
| 13. New York, | " | Beck, | 40·50 | 38·00 | . | . | . | 21·00 | |

What strikes us most in these various results, is the great difference with respect to the amount of water obtained, which ranges from 12·27 to 21. Upon calculating the oxygen ratios of all these serpentines, upon the assumption that 3 equivalents of water = 1 equivalent of magnesia, and deducting moreover the small amount of alumina that occurs in some of these serpentines as $\ddot{Al}\,\dddot{Si}$, we obtain the following proportions:

| | $\dddot{Si}$ : $\dot{R}$ | | $\dddot{Si}$ : $\dot{R}$ |
|---|---|---|---|
| 1. | 21·91 : 20·27 | 8. | 21·07 : 20·95 |
| 2. | 21·90 : 20·46 | 9. | 21·64 : 20·12 |
| 3. | 21·99 : 20·78 | 10. | 21·61 : 19·96 |
| 4. | 20·03 : 20·34 | 11. | 20·82 : 21·28 |
| 5. | 21·30 : 21·09 | 12. | 22·18 : 20·52 |
| 6. | 20·93 : 20·95 | 13. | 21·04 : 20·93 |
| 7. | 21·65 : 20·39 | | |

or as a mean of these thirteen ratios, 21·39 : 20·62; or in other words, 100 : 96·4.

* In this analysis the complete separation of the $\ddot{Al}$ from the Mg, was carefully attended to.

Whence we may infer, first, that all the serpentines in question, *notwithstanding their very different amount of water*, give very nearly one and the same oxygen ratio of $\ddot{Si}$ to $\dot{R}$, as soon as we conceive their water to be replaced by magnesia in the proportion of $3\dot{H} : 1Mg$; and secondly, that this oxygen ratio, which from the mean of thirteen analyses is 100 : 96·4, may, disregarding the trifling discordance, be put down as = 1 : 1. This discordance of 3·6 per cent. is easily explained when we take into consideration the difficulty that there is in obtaining serpentine completely pure, and entirely free from all mechanical admixture, and how liable this mineral is, either by being dried at too high a temperature, or in consequence of becoming weathered, (whence it also takes up a small amount of carbonic acid,) to part with a small quantity of its water.

From the oxygen ratio, $\ddot{Si} : \dot{R} = 1 : 1$, we deduce for all serpentines, the simple formula of $[\dot{R}]^3\ \ddot{Si}$, the bracket including the $\dot{R}$ signifying that in this member a greater or lesser portion of the magnesia and bases isomorphic therewith, as for instance, Fe, Mn, and so forth, is replaced by a corresponding quantity of water in the ratio here stated. *This formula is however at the same time that of olivine*, $[\dot{R}^3\ \ddot{Si},]$ with this difference merely, namely, that in the latter *no magnesia* is replaced by water. *Hence, serpentine is to be looked upon as a hydrous olivine*, or in other words, as an olivine in which the water, as an isomorphic constituent, replaces a greater or less amount of the 1 : 1 atomic bases, whence we arrive at an explanation of the known fact, *that the crystallized serpentine from Snarum is of the same crystalline form as olivine. What aspasiolite is to cordierite, serpentine is to olivine.*

The remarkable serpentine crystals from Snarum, (some of which, with a corresponding width and thickness, attain the length of four inches and above,) have been held by some mineralogists to be pseudomorphous crystals of olivine. Whoever is acquainted personally with their locality, will assuredly refuse to adopt this view.*

The olivine form of these crystals, furnishes of course no direct *proof* of the conversion; it only engages us to endeavor to *seek for* such a proof. No such proof has hitherto been found, neither is it probable, as I have convinced myself by a careful in-

* Tamnau, who visited the localities some years ago, has already expressed himself to that effect. See Pogg. Ann., vol. xlii, p. 462. Also, Böbert in *Gäa Norvegica*, part i, p. 135.

spection of the localities in question, that it will ever be met with. Not any where in the Snarum serpentine, is there any indication of that weathering or other decomposition of the rock, universally observed as accompanying such pseudomorphs as are here treated of. The crystals of serpentine, in themselves perfectly fresh and colored green by silicate of the protoxyd of iron, are either imbedded in magnesite not less fresh and showing brilliant planes of cleavage,* or else they occur in perfectly undecomposed titaniferous iron. Now and then upon breaking up the latter, portions of serpentine are met with *imbedded therein*. There are not met with here either clefts, cracks, or drusy cavities, indicative of any infiltration, formation of veins, or any thing of that kind; but serpentine, magnesite, titaniferous iron, mica, and some few other minerals met with here, occur closely and intimately mixed up together, forming a ribbon-shaped zone in the primitive gneiss, as has been demonstrated by Böbert in his article "Upon the Serpentine Formation in the primitive district of Modum."†

There are met with, it is true, at this locality, crystals of serpentine more or less weathered, in which case, owing to the protoxyd of iron being raised to the peroxyd, they are of a dirty yellow or brownish color, and indeed most of the specimens preserved in collections present that appearance; the reason thereof is simple enough, and noways bears out the olivine hypothesis.

All these crystals are obtained from the upper portion of the rock where exposed to the weather, or else they are imbedded in the numerous detached fragments that have rolled down below, and which have been lying for years upon the moist ground exposed to the action of the air and humidity. These crystals, owing to the facility with which the magnesite (filled as it is with fissures) breaks to pieces in consequence of this action, are detached very easily from their matrix, whereas with crystals that are quite fresh, and obtained by blasting from the lower portions of the serpentine mass, it is very far from an easy matter to remove entirely the surrounding matrix in which they are so closely and intimately imbedded.

(*To be continued.*)

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* This was formerly supposed to be bitter-spar. See Pogg. Ann., vol. lxv, p. 292.
† See Gäa Norvegica, part i, p. 127.

## Art. XLV.—*Matteucci's Lectures on Living Beings.**

The name of Matteucci has long been connected with researches on the physical phenomena of living beings, and especially with investigations into the agency of electricity in these operations. His mind has gone forward in experimental investigation, unbiassed by prevailing speculations, pursuing truth with the teachable spirit required of the student of nature, and with an earnestness and fertility of resource, rarely if ever exceeded. His statements are, therefore, entitled to the highest consideration. He finds no support for a common speculative opinion that an animal is a machine moved by electricity; yet traces out analogies between the different forces that are of great interest.

His lectures were delivered before the University of Pisa. They were published in Italian and have since appeared in French and English; the latter edition is from a corrected copy, by the author, with important recent additions. The topics treated of, include all the phenomena of living beings that are properly physical, and Matteucci successfully endeavors to show that many deemed vital are in fact of this kind. He takes up the following subjects in order:—Molecular Attraction—Capillarity—Imbibition—Endosmose—Absorption—Digestion—Reproduction—Nutrition and Animal heat—Phosphorescence of Animals and Plants—Electrical effects—Action of Gravity,—Light and Caloric,—Nervous force—Muscular Contraction—Circulation—Voice—Hearing—Vision. The researches relating to muscular electricity and the relations between electricity and the nervous force have never been properly noticed in this Journal, and we continue this review of the work by citations of passages, which will exhibit, though imperfectly, the facts to the reader, referring to the work, which cannot be too highly recommended, for a fuller account.

'*Galvanoscopic Frog.*—A frog is prepared according to Galvani's usual method; that is, we cut it through the middle of its pelvis, separate carefully all the muscles of the thigh, and divide one of the lumbar plexuses as it passes out of the vertebral column. We then have a leg of the frog united to its long nervous filament or the crural nerve (see B, part of fig. 2, p. 394).

The frog thus prepared,—which I have called the *galvanoscopic frog*—is very useful in researches on the electric current. For this purpose we introduce the claws of a frog into a glass tube covered with an insulating varnish, take hold of the tube with the hand, and afterward bring any two parts of the body,

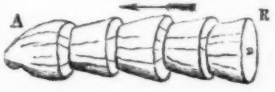
* Lectures on Living Beings, by Carlo Matteucci, Professor in the University of Pisa, with numerous wood-cuts. Translated under the superintendence of Jonathan Pereira, M.D., F.R.S., Vice President of the Royal Medical and Chirurgical Society. American Edition, Lea & Blanchard, Philadelphia.

whose electric state we wish to examine, in contact with two different and sufficiently distant points of the nervous filament of the galvanoscopic frog.'

'*Electric current in muscles.*—Furnished with a frog, thus prepared, I take a living animal, a pigeon for example, slightly cut its pectoral muscle, and apply the extremity of the nerve to the bottom of the wound, and another portion of the nerve to the lips of the wound, or better still to the external surface of the muscle; the frog continually contracts. This experiment clearly demonstrates the presence of an electrical current. The phenomenon witnessed in the pigeon takes place in every other animal, whether warm or cold blooded. I have recently proved that the galvanoscopic frog gives the same signs when we operate upon a wound made in the muscle of a man. But it is necessary to have recourse to the galvanometer to place beyond doubt the existence and character of this current. I expose the pectoral muscle of a living pigeon, I make a wound in it, and quickly convey the two platinum extremities of a very delicate galvanometer, the one to the external surface of the muscle, the other to the interior of the wound. The needle instantly deviates from 15° to 20° and even more; thus demonstrating the existence of a current, whose direction is from the internal part of the muscle to the surface of the same muscle.'

'*The muscular pile.*—I take five or six frogs, prepared after the manner (already mentioned) of Galvani; I cut them in halves, separate the thighs from the legs by disarticulation, and divide the thighs transversely into two parts. I thus obtain a certain number of the halves of thighs, from among which I select those only which belong to the lower portion; I arrange this series of demi-thighs upon a varnished tray, having a series of cup-shaped depressions or cavities, placing each in such a position that its external surface is in contact with the internal surface of the preceding. Here then we have a pile of demi-thighs of frogs, of which one extremity is formed by the external surface of the muscle, the other by the internal surface. I fill the two cups with a weak saline solution, or even with distilled water; plunge into them the two extremities of the galvanometer, and immediately a deviation of the needle is seen, which, before the immersion of these conductors, was at 0°. Thus the presence of an electric current produced by a pile formed of the muscles of the frog is demonstrated by the galvanometer.'

Fig. 1.




'I may add that I have recently succeeded in forming a muscular pile with *living pigeons*, similar to that made of living frogs. I have proved that the muscular current becomes more rapidly weak, and ceases sooner with pigeons than with frogs.'

The intensity of the current is in proportion to the number of demi-thighs or pigeons employed to form the pile. Matteucci ascertained by various trials that this current did not depend on the nervous system.

'The origin of this current resides in the electric conditions which are produced by the chemical actions of the nutrition of the muscle. The blood charged with oxygen, and the muscular fibre which becomes transformed on contact with this liquid compose the elements of a pile; they are the liquid acid and zinc.'

Matteucci, in his *tenth lecture*, treats of electric fishes, showing the identity of the force with electricity and its general character in different animals. In concluding this subject, he speaks of what he designates the proper current of the frog.

*Proper current of the frog.*—After mentioning a simple mode of experiment, he says: 'The signs of the current are augmented in intensity, if in place of a single frog, I form a pile with a number of them. This arrangement is very easily understood: I employ the varnished tray before spoken of, when treating of the muscular current. I place on it some frogs, prepared in such a way that the nerves of the first animal touch the legs of the second, and the nerves of the second, the legs of the third, and so on. I thus have a pile, one extremity of which is formed by the legs, and the other by the nerves. I plunge the two poles of this pile into cavities of the tray, which contain either a very weak saline solution, or distilled water. Into these I also put the two extremities of the two wires of the galvanometer. It is seen that the needle deviates, and indicates precisely, as in the experiment of Nobili, the existence of a very energetic current which circulates from the legs to the nerves in each of the frogs which form the pile. I have repeated and varied in a thousand ways this experiment, which has enabled me to ascertain that the variation of the needle is proportional to the number of frogs composing the pile; that it is more considerable when we employ an alkaline or saline solution, or better still, an acid solution, than when we employ distilled water; that, whatever be the liquid employed, the direction of the current is constant, and circulates always in the pile from the feet to the upper part of the frog. Recently, by studying more attentively the proper current, I have satisfied myself that it is a phenomenon which appertains to all animals.'

'Having thus ascertained the conditions on which the proper current depends, I think that I may generalize its origin, and connect it with the muscular current. This community of origin is principally demonstrated by the identity of action which the different circumstances that modify the organism and life of animals, exercise upon the muscular current.'

'Anatomists, and especially Bowman, have lately demonstrated, that the elementary muscular fibres are immediately continuous with the tendinous fibres, and that the sarcolemma which invests the muscle, ceases abruptly where the tendon begins. We may, then, with some probability, consider the tendon as being in the same electric condition as the interior of the muscle, and therefore, when we form, by means of a good conductor, a circuit or communication between the tendon and the sarcolemma, we put into circulation a portion of the muscular current.'

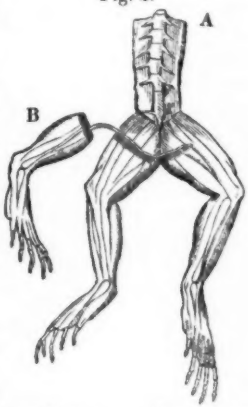
Lecture eleventh is occupied with the physiological action of gravity, light and color. Lectures 12 and 13 treat of the physiological action of the electric current; Lectures 14, 15, of the nervous force. With regard to the nerves, he observes that in the present state of science, and with the means of experimenting which we at present possess, no sign of an electric current is found in the nerves of living animals. Among his experiments, one was performed on a horse. 'We employed a very delicate galvanometer; the nerve was exposed for a considerable extent of its course, and I could traverse it with the platinum extremities of the galvanometer, by passing from a distance of two or three centimeters to that of fifteen or twenty. We never obtained distinct signs of the derived current, and in a constant direction, even when the muscles of the animal were violently contracted. I may add that from what we know of the properties of electricity, and of the laws of its propagation, it is impossible to conceive the existence of a current circulating in the nerves. In order that an electrical current should pass from one extremity of the nervous system to the other, it would be necessary to compare the nerve to a metallic wire varnished or otherwise insulated, an assumption which is not in accordance with fact. An electric current which, subjected to the will, would set out from the brain to reach the muscles, by traversing the nerves, could not be stopped in its course by the ligature of the nerve; whereas we well know, that the propagation of the nervous force is prevented by that proceeding. Lastly, its circulation in the nerves requires that the nervous system should form a closed circuit; but the labors of anatomists are very far from having proved such an arrangement, especially in the ultimate ramification in the muscles where it would be especially necessary.'

'This unknown force of the nervous system is therefore not electricity, and still less is it the electric current. But what connection exists between it and electricity, or the electrical current? In order to reply to these questions, I will here sum up, in a few words, the only positive result that my lengthened investigations of electro-physiological phenomena of animals have permitted me to deduce.'

'There exists, between electricity and the nervous force, an analogy which, if it does not possess the same degree of evidence, is, however, of the same kind as those analogies which we know to exist between caloric, light and electricity. We have seen, when speaking of the phenomena presented by electrical fishes, that the faculty which they possess of producing electricity is obedient to the nervous system. There is, then, in these animals, a peculiar organic structure, such an arrangement of parts that by an act of nervous force, they can develop the electric fluid. You remember the identity of causes and circumstances which excite and modify muscular contractions, and this function is proper to these animals. You have seen that in them the property which they have of giving the discharge, is under the immediate dependence of the functions of the nervous system, as well, also, as is the faculty which the muscles have of contracting.'

Matteucci's experiments on *induced contraction* are highly important. He says—'I shall commence by briefly stating in what this phenomenon consists, and by detailing the principal researches which I at first made to determine its laws. Having prepared a galvanoscopic frog, (B) we place its nerve upon one or both thighs of a frog prepared in the ordinary manner (A); then by applying the two poles of a pile to the lumbar plexus of the latter, we observe that when the muscles of the thighs contract, convulsions simultaneously occur in the galvanoscopic claw, whose nerves rest upon the thighs in contraction.'

Fig. 2.




'I have also ascertained that this phenomenon likewise occurs when we place the nerve of a galvanoscopic frog upon the muscles of the thigh of a rabbit, and make these contract by means of a current acting upon the nerve which ramifies in the thigh. I have also observed contractions of the galvanoscopic frog, without the employment of the electric current to excite the contractions of the muscle, producing the induced contraction; the action of some other stimulant, applied to the spinal marrow or the lumbar plexuses, being substituted.'

'Lastly, I have repeated these experiments by placing very fine layers of different substances between the nerve of the galvanoscopic frog, and the muscular surface where the induced contraction is developed. A leaf of gold, or a very thin and insulating lamina of mica, or glazed paper, being interposed, prevents

the production of the phenomena; that is to say, the contractions by induction do not occur in the galvanoscopic frog; but on the contrary, a leaf of fine paper moistened with water, does not prevent the occurrence of this contraction.'

Various experiments were performed with great care by Matteucci, to ascertain the true nature of the cause of these contractions, and he concludes that they are due to a nervous force and not to electricity. In the course of his argument on this subject, he says:—'We might believe in the development of electricity independently of the proper and muscular currents. But how can we suppose such a fact, when we see that the induced contraction is transmitted through certain insulating substances such as turpentine, oil, &c., while it no longer does so if we employ very thin leaves of mica. We might suspect that electricity, developed during muscular contraction, acted by influence. In this hypothesis, we can understand why turpentine offered no obstacle to the passage of the contraction by induction; but the other fact, that with an extremely thin plate of mica, the same result does not happen, makes it doubly inexplicable. I have tried the effect of covering a galvanoscopic frog, placed on a glass plate, with a plate of mica; the discharge from a Leyden bottle, passed between the knobs of the excitor upon the mica plate, and contractions were excited in the galvanoscopic frog. I shall not now stop to analyze this fact; it is sufficient for the present to show, that induced contraction through the mica ought to have occurred, if the cause of the phenomenon resided in an electric discharge, or was the result of the latter. I shall conclude by adding that I have endeavored repeatedly, but always unsuccessfully, to excite contraction in the frog by holding the nerve of the galvanoscopic frog in proximity with, or even in contact with a metallic conductor traversed by an electric current. In order to find out the most favorable conditions, and in order that the circuit by induction should be formed and completed in the frog, I prepared the latter in such a manner that a long nervous filament, that is, one of the lumbar plexuses, and its prolongation in the thigh, were exposed. The remaining portion of the body was left entire, and its two legs untouched. I suspended the frog by silken cords, in an horizontal position, and its nervous filament being in contact and parallel with the voltaic conductor, which was varnished. When all these precautions are taken, in order that the frog may be perfectly insulated, we never observe contraction excited in the latter, at the commencement, at the opening, or at the closure of the circuit of the pile. It must be remarked, that in this experiment the circuit by induction may take place completely in the frog. I employed Bunsen's pile of ten elements without obtaining any other result.'

'From all this it appears, that there is no experimental evidence in favor of the explanation of the phenomenon of induced contraction, by the assumption of the development of electricity during muscular contraction.'

'We are, then, still ignorant of the cause of muscular contraction, and all that we know of this phenomenon are the following particulars: it is produced, even when acting at great distances from the muscle upon the nerve, whose ramifications it receives; the integrity of the nervous filament from the point where the excitation takes place to the muscle itself, is indispensable; this transmission is effected with such rapidity, that we are compelled to compare it to that of electricity, light, and radiant caloric, propagating itself through various media; what modifies, augments or destroys the accomplishment of the chemical physico-phenomena of the nutrition of the muscle, has an analogous action upon its contractibility, provoked by any influence acting upon the nerves; and lastly, in the laws of the contraction of a muscle, we find an analogy with the physical laws of elasticity. The fact of induced contraction will, then, be a phenomenon of induction of this unknown force, which circulates in the nerves and produces muscular contraction.'

The following views are presented on the *production of nervous force.*—'In conclusion, let us say a few words on the production of the nervous force. Although it be true that we possess no knowledge of it except in living animals, and consequently want the apparatus to accumulate it and study its laws, out of the animal itself, yet we should not abandon all physical analogies in the investigations which we make relative to its mode of production. Whenever a movement occurs, or the effect of force is manifested, we are certain that some transformation of matter must have taken place. Wherever a force is exerted, a chemical action precedes it. Caloric, electricity and light, furnish us at every instant, with evidence of this truth. But putting aside all analogies, let us examine the conditions under which the development of what we call nervous force, takes place in animals. A man or animal after a long walk, having put his machine into motion, is fatigued, and needs repose and nourishment. Although it be true that facts are wanting to establish an intimate and really scientific connexion between the effects of labor, repose and nourishment on one hand, and of the loss and reparation of nervous force on the other, yet we cannot abstain from discussing these facts, complicated though they be, on the principles of mechanics and general physics.

'Muscular action, of whatever kind, is constantly followed by a loss of power, and as we see the animal machine recover its aptitude for exercise after having obtained food and rest, we must admit that the force necessary to muscular action may arise from

the chemical actions of nutrition; inasmuch as by means of the latter, and of repose, this force is reproduced and accumulates in the nervous system. Interrupt for a certain time the sanguineous circulation in a muscle, and soon this becomes incapable of contracting; but with the return of blood, the muscular force revives. In animals, where circulation and respiration are very active, the development of muscular force is more considerable.'

'But among the numerous chemical actions that occur in animals, which is the one that gives rise to the force that is put in action during muscular contraction? It is impossible to give a satisfactory answer to this question. Physiologists now admit that heat is produced by the combustion of fatty matters, and principally by that of bodies into which fecula is transformed during digestion; the nervous force may be due to chemical actions which take place during the changes which the neutral azotized substances of the tissues undergo. But I know of no experiment which directly proves this difference of origin, between heat and the nervous force. Of all chemical actions of which the animal is the seat, the only one which we perfectly know, and which we have even measured, is that which produces carbonic acid. On the average, man converts and exhales, in the form of carbonic acid, ten to fifteen grammes of carbon per hour.'

Matteucci, in continuing this subject, adduces the calculation that a man in the course of a journey consumes $\frac{1}{3}$ to $\frac{1}{4}$ the quantity of carbon required for a locomotive to carry him the same journey; and after other observations, concludes that the 'work produced from nervous force derived from a certain chemical action, is much greater than that which this same action produces when converted into heat.'

In the Comptes Rendus for the 15th of March, 1847, Matteucci has given the following summary of his hypothetical views respecting the nervous force:

1st. The nervous fluid is produced by the chemical actions of nutrition.

2d. This fluid, developed principally in the muscles, is diffused there, and being endowed with a repulsive force between its parts like the electric fluid, retains the elements of a muscular fibre in a state of repulsion analogous to that presented by electrified bodies.

3d. When this nervous fluid ceases to be free in the muscle, the elements of the muscular fibre mutually attract each other, as we see happens in cadaveric rigidity.

4th. This nervous fluid enters continually into the nerves, and from them passes to the brain, assuming in these bodies a new state which is no longer that of the free fluid; in this manner it passes from the muscle to the nerve. According to the quantity of this fluid which ceases to be free in the muscle, the contraction is more or less strong.

5th. This state is that of the nervous current, or species of discharge which proceeds from the nervous extremities to the brain, and returns in a contrary direction by an act of the will.

6th. When this discharge takes place, muscular contraction ought to take place, the fluid ceasing to be free in the muscles.

7th. This discharge of nervous fluid, acting as in the electric fish, explains the induced contraction; in both cases and by the same disposition of parts, the nervous current produces a species of electric polarization of the elements, either of the muscular, or of the electric apparatus; the difference of effects will be due to a different number of elements, to their dimensions, &c.

8th. The electric current impedes the nervous discharge, if it be directed in the contrary direction; as in the direct current: the nervous fluid not being able to enter and accumulate in the nerve, this loses its excitability. The contrary takes place for the inverse current, which goes in the same direction as that of the nervous discharge: the nervous fluid is found accumulated in the nerve, and its excitability is augmented.

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## Art. XLVI.—*Correction of Errors found in several Mathematical Tables;* by A. D. Stanley.

In compiling a set of mathematical tables, published a few months since, several errors were found by the writer in different tables which he had occasion to examine. A list of them is given below, for the use of those who have copies of the tables referred to.

*Babbage's Table of Logarithms of Numbers: second edition; London*, 1831.

Log. 10354 (p. 6.) The first of the figures 1082 should be in small type.

Log. 60676–7–8–9. } The cipher in each of the loga-
Log. 70634–5–6–7–8–9. } rithms should be in small type.

*Hutton's Mathematical Tables: latest editions.*

Log. 24626, for 3913940 read 3913939.

*In the Traverse Table,*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dist. | 5, | course | 3½ | pts. | for | lat. | 3·8650 | read 3·8651 |
| " | 6 | " | 41° | " | | dep. | 3·9363 | " 3·9364 |
| " | 8 | " | 19 | " | | lat. | 7·5642 | " 7·5641 |
| " | 8 | " | 27 | " | | lat. | 7·1280 | " 7·1281 |
| " | 9 | " | 16 | " | | lat. | 8·6513 | " 8·6514 |
| " | 9 | " | 32 | " | | dep. | 4·7093 | " 4·7693 |
| " | 9 | " | 38 | " | | dep. | 5·5409 | " 5·5410 |
| " | 10 | " | 16 | " | | lat. | 9·6120 | " 9·6126 |
| " | 10 | " | 16 | " | | dep. | 2·7562 | " 2·7564 |

*Vega's Logarithmisch-trigonometrisches Handbuch: 5th edition; Leipzig*, 1820.

sin 0° 0′ 30″–40″, diff. 1″, for 124938 read 124939.

cos 1° 16′ 20″, for 9·9998529 read 9·9998929.

sin 2° 29′ 50″, for 8·6391970 read 8·6391971.

And in the adjacent differences for 1″, instead of 483·0 and 482·6 read 483·1 and 482·5.

tan 5° 7′ 40″, for 8·9529683 read 8·9529682.

cot 5° 7′ 40″, for 11·0470317 read 11·0470318.

And in the adjacent differences for 1″, instead of 236·6 and 236·4 read 236·5 and 236·5.

cos 35° 26′, for 9·9110450 read 9·9110460.

cos 43° 53′, for 9·8577862 read 9·8577863.

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*Vega's Thesaurus Logarithmorum: Leipzig*, 1794.

p. 55, Log. 24626, for 3939751 read 3938751.

p. 435, sin 12° 33′ 40″, for 9·3374109 read 9·3374209.

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*Callet's Tables Port. de Logarithmes: latest editions.*

Log. 60844, for 7842177 read 7842178.

Log. 99018, for 9957141 read 9957142.

Table I, p. 189, Log. 1099, for 7·00211 read 7·00215.

Table III, p. 200, Diff. I, opposite 00132 Log. for 54589 read 34589.

Table for converting hyperbolic into common logarithms, p. 213, opposite 8, for 9032 read 9031.

In the edition of 1843, for Log. 59179, instead of 7721610 read 7721676; for Log. 59189, instead of 7722476 read 7722410.

The last error is corrected in the edition of 1846.

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*Lalande's Tables de Logarithmes, étendues a sept décimales, par Marie: second impression; Paris*, 1835.

Log. 1200, for 0791813 read 0791812.

p. 114, cosin 0° 1′, for 9·9999999 read 10·0000000.

p. 156, in the first column of *differences*, all the numbers are wrong: the leading figure in each should be 3 instead of 5.

In the columns headed 4685, on pages 114, 115, 116, 117, about seventy of the numbers are erroneous in the final figure. These numbers are generally such as result from subtracting, in each case, the logarithm of the proper number of seconds carried to seven places of decimals, from the logarithmic sine or tangent carried to the same number of decimals; whereas, to secure to the difference the

utmost accuracy in the seventh decimal place, more than seven decimal figures should be taken account of, in the minuend and subtrahend. We will give here only the correction of one or two errors not thus occasioned.

p. 114, opposite 20′, for 5797 read 5798.
p. 116, opposite 8′, for 5463 read 5465.

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*Hassler's Logarithmic and Trigonometric Tables: New York*, 1830.

*Table of useful numbers on page* 11.

Arc equal to Radius should be 206264″·8 instead of 205264″·8. 1° in parts of Radius, should be 0·0174532925199 &c. instead of 0·017453294199 &c. The number given as the Modulus of common logarithms, is the reciprocal of this modulus; and the number given as the logarithm of this modulus is the modulus itself. This last number however should be 0·43429448 &c. instead of 0·434292448 &c.

*Table of Logarithms of Numbers.*

| | | | | |
|---|---|---|---|---|
| In place of the number | | 3485, | is put | 2485. |
| " | | 4380, | " | 4280. |
| " | | 6930, | " | 9930. |
| " | | 9968, | " | 9948. |

Where the three leading figures of the logarithms should be 861, they are 361; and where they should be 896, they are 886.

Log. 65798, for 8182129 read 8182127.

Log. 88320, for 9461591 read 9460591.

In the *table of logarithmic sines &c.*, for 56° is put 66°.

*Table of Natural Sines and Cosines.*

In each of the cosines from 7° to 7° 30′, the index should be 0 instead of 9.

(Some other errors in Hassler's Tables are noticed in vol. xxii, of the first series of this Journal.)

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*Shortrede's Logarithmic Tables: Edinburgh*, 1844.

| | | | | | | |
|---|---|---|---|---|---|---|
| p. 31, | Log. | 24451 | for | 3882996 | read | 3882966 |
| p. 43, | " | 38962 | " | 5906413 | " | 5906412 |
| p. 56, | " | 54033 | " | 7326541 | " | 7326591 |
| p. 59, | " | 57628 | " | 7606336 | " | 7606335 |
| p. 59, | " | 57629 | " | 7606410 | " | 7606411 |
| p. 64, | " | 63747 | " | 8044597 | " | 8044598 |
| p. 67, | " | 67951 | " | 8321958 | " | 8321959 |
| p. 81, | " | 85071 | " | 9296815 | " | 9297815 |
| p. 93, | " | 99286 | " | 9968800 | " | 9968880 |

p. 50, line 2 from bottom, for 729 read 728

*Table II.*

p. 195, opposite ·9980, for 4054 read 9954054

*Table of Useful Numbers.*

| | | | | | |
|---|---|---|---|---|---|
| p. 195, | No. 6, | for | 0·01688690 | read | 0·01688686 |
| " | No. 7, | " | 1·77245390 | " | 1·77245385 |
| " | No. 8, | " | 1·14472990 | " | 1·14472989 |
| " | No. 10, | " | 3437′·746770 | " | 3437′·746771 |

*Table III: Logarithmic Sines and Tangents.*

p. 136, cos 6° 42′ 39″ for 9·9970 42, read 9·9970142

In table xxxvii, (the traverse table,) are found precisely the same errors as those in Hutton's table above specified.

Some of those errors were in Sherwin's Traverse Table: Hutton, in copying that, introduced the others, and where his traverse table has been adopted in collections of tables, we seldom find any of the errors corrected.

A number of errors discovered in several sets of tables of less importance, it is not thought worth while to mention here.

The following numerical error in my own tables has been pointed out to me by a friend.

The logarithm of 34724 should be 5406297 instead of 5405297. I will add that in the Introduction, p. 23, 4th line from the bottom, the word *logarithm* should be changed to *number*.

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## SCIENTIFIC INTELLIGENCE.

### I. Chemistry and Physics.

1. *On the Decomposition and partial Solution of Minerals, Rocks, &c., by Pure Water, and Water charged with Carbonic Acid;* by Prof. W. B. Rogers, and Prof. R. E. Rogers, of the University of Virginia.*—The present brief notice is designed as a mere abstract of the more prominent results of our investigations in this very interesting field of experiment. The facts accumulated during upwards of four months of laborious research, have become so voluminous as to require further time for throwing them into a shape suited to a detailed publication, but we trust that the heads of our enquiry, here presented, will suffice at present to indicate the scope of the experiments and the great interest of many of the determinations, especially in their bearing upon the Chemistry of Geology, the formation of Soils, and the Nutrition of Plants.

It is matter of surprise that so little has hitherto been done to determine by *actual experiment, the solvent power of water and of carbon-*

* Communicated for this Journal, by the authors, in advance of a more extended memoir on the same subject which will appear in a future number.

*ated water*, upon mineral compounds. The only results heretofore published on the subject, so far as we are aware, are the comparatively isolated experiments of Struve, Forchhammer, and Polstorf and Wiegmann, as cited by Liebig in the last edition of his Agricultural Chemistry.* But these were of too restricted a scope to furnish a solid basis for reasoning *generally* on the disintegration of rocks, the formation of chalcedonic, zeolitic, and other minerals by solution, and the conveyance of inorganic materials into the structure of plants. Yet upon such slender experimental foundation rest the common theories of the decomposing and forming action of the meteoric waters.

It is obviously therefore a question of the first importance to decide, whether water, pure or charged with carbonic acid, possesses the *general* decomposing and dissolving power which some chemists have, vaguely and without sufficient evidence, ascribed to it, or whether this action is manifested only with the few materials hitherto tried and which all contain an *alkali*.

To resolve this question, has been the object of our labors, and we feel that we have been well rewarded by the result, proving, as it does most conclusively, *the solvent and decomposing power of pure and carbonated water upon all the important mineral aggregates, as well without as with alkaline ingredients.*

Our experiments have been of two kinds, first, by an *extemporaneous method with the tache*, and second, by *prolonged digestion* at the ordinary temperature.

In the former method, a small quantity of the mineral, some five or ten grains, in *very fine powder* is leached for a few moments on a small filter of purified paper, and a single clear drop of the liquid received on a platinum slip, is dried and examined by appropriate tests, before and after ignition. In the second process, a quantity (40 grains) of the finely powdered mineral, is placed with a certain volume (10 cubic inches) of the liquid, in a green glass bottle, and agitated from time to time for a prescribed period. The liquid separated by filtration is evaporated to dryness in a platinum capsule. The residuum is then critically examined and, if in sufficient amount, is submitted to quantitative analysis.

In both processes *two parallel experiments* are made, the one with pure de-aërated water, the other with water charged to saturation at 60° with $CO_2$. In the second process, the alkali, lime, &c., which may be dissolved by action on the containing glass, are determined by parallel experiments, with bottles of the same kind, charged, the one with simple water, the other with carbonated water, and exposed to the solvent action for the same time and with the same agitation as those containing the powdered minerals.

The following is a list of the minerals and other substances which we have subjected to *the analytic action of pure water and of carbonic acid water.*

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* See also a valuable memoir on the solubility of fluorid of calcium in water, &c., by G. Wilson, M.D., *Trans. Roy. Soc. Edinb.*, xvi, 145, 1846; and this Jour., ii ser., ii, 114.—Eds.

| | | |
|---|---|---|
| Potash felspar, 3 var. | Chlorite, 2 var. | Brown garnet. |
| Soda felspar. | Talc, 2 var. | Dolomite. |
| Lithia felspar. | Serpentine. | Flint glass. |
| Glassy felspar. | Steatite. | Green bottle glass. |
| Labradorite. | Olivine. | Green German glass. |
| Mica, 2 var. | Hypersthene. | Hard white Bohemia glass. |
| Leucite. | | |
| Analcime. | Hornblende, 2 var. | Wedgewood mortar. |
| Mesotype. | Actinolite. | Chinese porcelain. |
| Scolecite. | Tremolite. | |
| Schorl, 2 var. | Augite. | Anthracite. |
| Greenstone, 2 var. | Asbestus, 2 var. | Bituminous coal. |
| Chalcedony. | Coccolite. | Lignite. |
| Obsidian. | | Charcoal. |
| Lava. | Epidote massive. | Ashes of coal and wood. |
| Gneiss. | Epidote crystals, 2 var. | |
| Hornblende slate, &c. | Axinite. | Woods. |
| Soils. | Prehnite. | |

(1.) By the tache process we find *that all the minerals and glasses in this list are partially decomposed and dissolved by carbonated water, and most of them also by pure water.*

When the substance is *very minutely powdered*, before mingling it with the liquid, even the first drops that pass the filter will commonly give a tache containing some of the alkali or alkaline earth that has been dissolved. In this way proof of the solvent power of the *carbonated water* may generally be obtained in less than ten minutes after adding it to the powder. As the action is continued, by returning the liquid to the filter, the effect is increased. In the case of *simple water*, the result is much feebler, and requires a longer time. But with nearly all the substances enumerated, it is entirely unequivocal, and with some of them quite intense.

(2.) It is interesting to observe how from *a single drop* of the clear filtered liquid we obtain *distinctive* evidence of the presence of *alkalies or lime or magnesia.* The latter are indicated by the milkiness of the drop when reduced by evaporation on the platinum slip, as well as by the volume and whiteness of the tache. But further and more minute information is obtained by testing the tache before ignition, and again at successive stages of ignition. The *volatility* of the *three fixed alkalies* and their carbonates, we have found to be much greater than seems to be generally imagined. By carefully comparing them in this respect with one another and with lime and magnesia, we have been enabled to make very advantageous use of the blowpipe, in connection with test paper, in examining the tache, so as to recognize the alkalies and alkaline earths severally present in the tache of felspar, hornblende, serpentine, epidote, and other minerals.

These and other habitudes of the tache obtained with carbonated water, give this method unexpected value in the *quantitative analysis of minerals. It furnishes by far the easiest and most speedy method of discerning the presence of an alkali, or lime, or magnesia, in a mineral*, and we think therefore that it promises to become a useful auxiliary to the mineralogist, in connection with the ordinary blowpipe reactions.

(3.) By the *second method*, that of prolonged digestion, we have actually made with carbonated water, and even with simple water, *a partial analysis of a number of complex minerals.* The specimens exposed to the $CO_2$ water for forty-eight hours, and to the simple water for one week, have in many instances furnished a sufficient amount of material to the liquid, to admit of a quantitative examination. Thus, from *hornblende*, *actinolite*, *epidote*, *chlorite*, *serpentine*, *felspar*, *mesotype*, &c., we have procured a quantity of *lime*, *magnesia*, *oxyd of iron*, *alumina*, *silica* and *alkali*, *the dissolved ingredients of these minerals severally amounting to from* 0·4 *to* 1 *per cent. of the whole mass.* The lime, magnesia and alkalies are in the form of carbonates; the iron in the case of hornblende, epidote, &c., passing from the state of carbonate to that of peroxyd during the evaporation, collects in brown flocculi, along with the silica and alumina at the bottom of the capsule. Thus, 40 grs. of hornblende, digested for forty-eight hours in $CO_2$ water at 60°, with repeated agitation, yielded silica 0·08, oxyd of iron 0·05, lime 0·13, magnesia 0·095, manganese a distinct trace.

(4.) Most of the substances above enumerated, when finely powdered in an agate mortar, and moistened with pure water in a platinum capsule, *give decided alkaline reaction with test paper properly prepared.* Among the materials presenting this effect most strongly, are serpentine, chlorite, tremolite, asbestus, mica, hornblende, the felspars, and glass. The effect is especially striking with powdered glass. But it is important to note that *this reaction is more immediate and stronger with the magnesian and calcareo-magnesian silicates, than with the felspars and most other alkaline minerals.*

In making this and all the other experiments embraced in the present enquiries, it is of course necessary that the specimen should be free from any adhering carbonate of magnesia or lime, either of which would give rise to an alkaline reaction, and the former in quite a marked degree. It is moreover necessary to avoid using either a Wedgewood or glass mortar, as the abraded matter would in such case give to the carbonated water quite a discernable amount of alkali.

(5.) The comparative readiness with which the *magnesian and calcareo-magnesian silicates* yield to the decomposing and dissolving action of carbonated and even simple water, *is we believe a fact no less important than it is true.* It explains the rapid decomposition of the rocks composed mainly of hornblende, epidote, chlorite, &c., without calling in the agency of an *alkali*, and it accounts for the fact that rocks of this kind are often much more rapidly decomposed by meteoric actions than even the felspars themselves. It enables us moreover to trace the simple process by which plants are furnished with the lime and magnesia they require, from soils containing these silicates, without our having recourse to any mysterious decomposing power of the roots of the growing vegetable.

(6.) Among the points of interest incidentally determined during these investigations, may be mentioned the curious and instructive fact that *anthracite coal*, *bituminous coal*, and *lignite*, treated by the tache process, *give unequivocal evidence of alkali*, while the *ashes* of these materials similarly treated, yield *no trace of alkali.* It thus becomes evident that the absence of alkali in the ash of these combustibles, instead

of being a consequence of its absence in the coal itself, is really due to the *high temperature at which the ash is formed.* We have here the explanation of a fact which might otherwise appear inconsistent with the admitted vegetable origin of coal.

(7.) Another incidental result of interest, is *the extraction of carbonate of potassa from wood* by leaching it in fine powder, with carbonated water. This effect we have found to be quite distinct with maple, oak, hickory, &c. Hitherto the opinion appears to have prevailed that the alkali or its carbonate could only be eliminated by the *incineration* of the vegetable material.

From the great rapidity with which, according to our experiments, potassa and soda and their carbonates, but especially potassa and its carbonate, rise in vapor at a strong red heat, we are persuaded that *a large error must be committed in estimating the amount of these materials contained in plants, by the results of incineration*, and we believe that in not a few cases the quantity obtained is scarcely one-half of what really exists in the vegetable mass. The important bearing of this consideration upon the late numerous and elaborate analyses of ashes, should we think claim the special attention of chemists. Indeed it seems a little remarkable that the source of error here referred to, has not already been brought to the notice of analysts, as likely to modify materially their results.

2. *General Formulas for the Silicates and Borates;* by A. LAURENT, (Compt. Rend. des Trav. de Chemie, July, 1847, from Compt. Rend. de l'Acad., t. xxiii, p. 1050, and t. xxiv, p. 94.)—In these memoirs M. Laurent remarks upon the complication of the formulas generally admitted in the dualistic system, and upon the difficulties of classification after this system.

To avoid the numerous contradictions which render so difficult the study of the native silicates, he has reduced them to a small number of types with the following formulas, (admitting with the French chemists generally, that the formula of silicic acid is Si O, and representing by R an equivalent of hydrogen or a metal.)

| | |
|---|---|
| Silicates, . . . | $[Si\,O+2OR_2]=Si\,O_3\ (R_4)$ |
| Bisilicates, . . . | $[2Si\,O+2OR_2]=Si_2\,O_4\ (R_4)$ |
| Trisilicates, . . . | $[3Si\,O+2OR_2]=Si_3\,O_5\ (R_4)$ |
| Quadrisilicates, . . | $[4Si\,O+2OR_2]=Si_4\,O_6\ (R_4)$ |
| Quintisilicates, . . | $[5Si\,O+2OR_2]=Si_5\,O_7\ (R_4)$ |
| Sexsilicates, . . . | $[6Si\,O+2OR_2]=Si_6\,O_8\ (R_4)$ |
| Octosilicates, . . | $[8Si\,O+2OR_2]=Si_8\,O_{10}(R_4)$ |

M. Laurent admits that the molecules are divisible not into two or three parts, as some have supposed, but into a number of parts to which he assigns no limit. He conceives that all oxyds have the same formula as water, being $OM_2$, so that the protoxyd and peroxyd of iron are represented by the same number of equivalents. ($OFe^2$ = oxyd of ferrosum, and $OFe^4_3$ or $OFe^3_2$ = oxyd of ferricum.) He thinks that ferrosum and ferricum are isomorphous, and capable of replacing each other within certain limits in all proportions; in other words, that the protoxyd and peroxyd of iron, alumina, potash, soda, lime and water, may sustain the same relations in combination and mutually replace each other.

The following facts will show the grounds upon which this idea is supported. It is known that magnetic iron, spinel, chromic iron, gahnite, pleonaste and franklinite have the same crystalline form; these are regarded by chemists as combinations of an oxyd with three atoms of oxygen (alumina, chromic and ferric oxyds) with an oxyd of one equivalent of oxygen, as magnesia, protoxyd of iron and zinc. Thus with the equivalents of Berzelius,

Magnetic iron will be a ferrate of iron, . $Fe_2O_3+FeO$.
Chromic iron will be a chromite of iron, . $Cr_2O_3+FeO$.
Spinel will be an aluminate of magnesia, . $Al_2O_3+MgO$.
Pleonaste will be a ferro-aluminate of magnesia, $\left\{\begin{matrix}Fe_2\\Al_2\end{matrix}\right\}O_3+MgO$.
Franklinite will be a ferro-aluminate of zinc and magnesia, . . . . $\left\{\begin{matrix}Fe_2\\Al_2\end{matrix}\right\}O_3+\left\{\begin{matrix}Zn\\Mg\end{matrix}\right\}O$.
Gahnite will be an aluminate of zinc, . . $Al_2O_3+ZnO$.

The analogy of composition presented by these formulas, enables us to conceive how all these minerals may have the same form,* and would seem to forbid the idea of any similarity between the relations of the protoxyds and peroxyds. But on consulting the results of analysis, in place of the relation of 3 : 1 between the oxygen of the protoxyds and of the peroxyds, we find in

Gahnite, . . . . . $Al_3$ to $Al_6+Zn$.
Spinel, . . . . . $Al_6$, $Al_9$, $Al_{11}+Mg$.
Pleonaste, . . . . . $\left\{\begin{matrix}Al_5, Al_7\\Fe, Fe\end{matrix}\right\}+Mg$.

In chromic iron the FeO varies from 18 to 36 per cent., $Cr_2O_3$ from 36 to 60 per cent., and $Al_2O_3$ from 6 to 20 per cent. In the magnetic iron we find from $Fe_2O_3+FeO$ to $4Fe_2O_3+3FeO$.

How is it possible, demands M. Laurent, in view of such facts to suppose that in all these minerals the ratio of the oxygen in the two species of oxyds is as 3 : 1? How on the other hand, can we conceive that all these minerals or even the different spinels, should have the same form? But admit the divisibility of the molecules, and give to all these oxyds the same formula: the seeming contradiction which exists between the constancy of form and the change in the constitution of these minerals, then vanishes entirely. They may then all be referred to a type, the general formula of which is $\dot{O}(\dot{Al}, \dot{Fe}, Mg, Zn, Fe)_2$.

M. Laurent applies the same reasoning to the silicates; the formulas which he proposes include all the silicates known, and are at the same time exceedingly simple. He admits besides the preceding types, some others of basic salts, (the preceding formulas $+nOM_2$,) but it happens thus that two or three formulas become applicable to the same silicate. Thus we have—

Bisilicates, $Si_2O_4(R_4)$.
Basic trisilicates, $Si_3O_5(R_4)+O(R_2)=Si_3O_6(R_6)=1\frac{1}{2}Si_2O_4(R_4)$.
Bibasic quadrisilicates, $Si_4O_6(R_4)+2O(R_2)=Si_4O_8(R_8)=2Si_2O_4(R_4)$.
Quadribasic sexsilicates, $Si_6O_8(R_4)+4O(R_2)=Si_6O_{12}(R_{12})=3Si_2O_4(R_4)$.

* See M. Gerhardt's considerations upon the atomic volume of these oxyds, in this Journal, Nov., 1847, p. 405.

To avoid the uncertainty presented by the employment of these four formulas, in which the ratios are the same, M. Gerhardt observes that it will be preferable to consider these so-called basic salts as so many distinct types representing neutral salts.

The formulas of the borates are arranged upon the same principle as those of the silicates. He admits three principal types.

1st. $[2B_2O_3+OR_2]=B_4O_7(R_2)$.
2d. $[\frac{1}{2}B_2O_3+OR_2]=BO_2(R)$.
3d. $[\frac{1}{2}B_2O_3+2OR_2]=BO_3(R_3)$.

To the first he attaches a basic sub-type, $B_4O_7(R_2)+O(R_2)$, which in accordance with M. Gerhardt's plan might be equally made a distinct type, $B_4O_8(R_4)$, which appears to be identical with the second order. T. S. Hunt.

3. *On Phosphamid;* by M. Gerhardt, (Ann de Pharm. et de Chimie, June, 1847.)—The researches of the author upon the so-called phosphuret of nitrogen, have been already noticed;* but the present notice describes a new reaction, which is quite conclusive as to the nature of the compound. If the phosphamid ($PH_3N_2O$) is gently heated with sulphuric acid, diluted with water so as to form the hydrate $SO_4H_2+1\frac{1}{2}Aq$, it is completely dissolved without any disengagement of gas, and the syrupy liquid deposits, on standing, colorless crystals of *bisulphate of ammonia*, which may be obtained pure by washing with alcohol. The mother liquid saturated with ammonia, gives with nitrate of silver a precipitate of the yellow phosphate.

$PH_3N_2O+2[SO_4H_2+1\frac{1}{2}H_2O]=2[SO_4H_2NH_3]+PO_4H_3$.

The *biphosphamid* PNO corresponds to the protoxyd of nitrogen, $N_2O$.† M. Gerhardt has shown that this last is really an amid of nitric acid, and yields ammonia and a nitrate when it is passed over a mixture of lime and potash at a sufficiently high temperature. As phosphorus and nitrogen are capable of replacing each other, we have then—

| | |
|---|---|
| PNO, . . . | Biphosphamid. |
| NNO, . . . | Nitrous oxyd. |
| $PO_3H$, . . . | Metaphosphoric acid. |
| $NO_3H$, . . . | Nitric acid. |

[This discovery of the real nature of nitrous oxyd is one of great interest, and tends to enlarge our ideas as to the possible constitution of many chemical compounds. The formation of this substance and its action with heated alkalies, show that it is not a simple oxyd, and lead us to the seemingly strange conclusion that the nitrogen in it, really exists in two different conditions, and endowed with different affinities. The reaction by which nitrous oxyd is formed from the ammoniacal salt, consists directly in the abstraction of the elements of two equivalents of water, a reaction analogous to that by which formate and ace-

* See this Journal, Jan., 1847, p. 105.

† It will be recollected that M. Gerhardt divides the equivalents of nitrogen and phosphorus received by the English chemists by 2; those of hydrogen and the metals, and consequently the formulæ of salts generally, are in like manner halved. The formula of nitrous oxyd according to the common notation, must now be $N_2O_2$ or $NNO_2$. For some considerations upon the equivalents of hydrogen and the metals, see this Jour. for Sept., 1847, p. 171.

tate of ammonia yield prussic acid and acetonitrile.* The action of anhydrous phosphoric acid upon the nitrate, would probably produce a similar result.

It is curious to observe that this decomposition is precisely similar to that which nitrite of ammonia undergoes by heat.† Losing the elements of two equivalents of water, it evolves *nitrogen gas.*

| | |
|---|---|
| Nitrate of ammonia, . | $NO_3H, NH_3 - 2H_2O = NNO.$ |
| Nitrite of ammonia, . | $NO_2H, NH_3 - 2H_2O = NN.$ |

Are we warranted in inferring from this analogy that nitrogen gas thus obtained, apparently identical with the nitrogen of the atmosphere, is really composed of two equivalents of the element, sustaining toward each other the same relations as the two equivalents in nitrous oxyd? And shall we thus explain the indifference which free nitrogen exhibits to all chemical agencies? Such an idea may be regarded as a mere speculation, but although we have not yet evidence of the truth of so startling a proposition, it is a possible fact which should not be disregarded.] T. S. H.

4. *On the Nature of Hydrofluoric Acid;* by M. Louyet, (Jour. de Pharm. et de Chimie, Sept., 1847, from the Compt. Rend. de l'Acad., t. xxiv, p. 434.)—It has been supposed that the anhydrous hydrofluoric acid was capable of being condensed at the ordinary pressure into a liquid, but the experiments of M. Louyet show that this contains water. He has obtained the pure dry acid by the aid of anhydrous phosphoric acid; it is gaseous under the ordinary pressure at $-12°$ C. (10° F.); it fumes strongly in the air, and scarcely attacks glass. T. S. H.

5. *On the Quantitative Determination of Sulphur in Organic Substances;* by W. Heintz, (Annal. de Pharm. et de Chemie, from Pogg. Annal., t. lxxi, p. 145.)—M. Heintz recommends the following process as requiring but a small portion of the organic substances, and especially adapted to the analysis of the protein bodies. The substance is burned with oxyd of copper in a stream of oxygen gas, as in the ordinary process of organic analysis. The combustion tube is connected with a tube such as is used for the acid in Will and Varrentrapp's nitrogen process, filled with a solution of potash free from sulphate. The end of the combustion tube is drawn out to a point, and bent at an obtuse angle, so that the extremity may be introduced into the end of the potash tube; the joint is made tight by gum-elastic. This arrangement is to prevent the loss of any sulphuric acid which might be evolved in the process.

When the combustion is finished, the liquid is poured into a warm mixture of chlorate of potash and hydrochloric acid; the sulphite is thus converted into sulphate. The whole contents of the combustion tube are then dissolved in this liquid with a gentle heat, and the sulphate finally precipitated by chlorid of barium.

As a proof of the accuracy of this method, M. Heintz has made the analyses of taurine, operating on from 0·174 to 0·191 grammes, and obtained of sulphur 25·68, 25·66 and 25·49 per cent. Theory requires 25·60. T. S. H.

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* This Journal, for Jan., 1848, p. 119. † Ibid, for March, 1848.

6. *On Isomorphism;* by MM. LAURENT and BERZELIUS, (Ann. de Pharmacie et Chimie, April, 1847.)—Certain bodies are known in which, although containing the same elements in the same proportions, and presenting the same crystalline form, the relative order of the elements is not the same.* Thus we have—

A hydrobromate of chlorinized cinchonine: $C_{19}(H_{20}Cl_2)N_2O,H_2Br_2$.

A hydrochlorate of brominized cinchonine: $C_{19}(H_{20}Br_2)N_2O,H_2Cl_2$.

These two salts have the same composition and are isomorphous. Notwithstanding their great resemblance however, they are not identical, as it is easy to determine by the action of potash. This alkali separates from the one, brominized cinchonine, and is converted into a chlorid, while with the other salt, it precipitates chlorinized cinchonine, and forms a bromid of potassium.

This important fact observed by M. Laurent, is one of those which demonstrate most forcibly the falsity of the dualistic theories which have been applied to organic chemistry.

M. Laurent concludes his remarks upon this point by observing, "If the partisans of the electro-chemical theory do not find that I have brought proofs enough in support of my thesis, I beg that they will indicate what experiments are still necessary to persuade them that they are in error; as for myself, I do not know what farther proof it is necessary for me to give them."

The reply of Berzelius is curious; "M. Laurent demands that we receive these facts as proofs. Does he not perceive that opinions do not differ as to the facts, which can be demonstrated, but as to the light in which we are to regard them? *But this last requires a sagacity in conception, and a clearness in ideas of which he has no right to demand of any one more than nature has given him.*" T. S. H.

7. *On the Products of the Action of Cyanic Acid upon Alcohol and Aldehyde;* by MM. LIEBIG and WŒHLER, (Jour. de Pharm. et de Chimie, from Annal. der Chem. und Pharm., t. lix, p. 291.)—The combination of cyanic acid and alcohol, described by Liebig as the bicyanurate of oxyd of ethyle, presents a composition quite different from that of other ethers, inasmuch as it is formed by a direct combination of the alcohol and acid, without the separation of the elements of water. The late researches of Liebig and Wœhler have explained this anomaly by showing that it is really the ether of a new acid, differing from the cyanic by the elements of water, to which they have given the name of *allophanic acid.*

When this ether or its methylic homologue is dissolved in baryta water, or triturated with a mixture of water and hydrate of baryta in the cold, a solution is obtained which after some days repose in a close vessel, deposits mamillary crystalline masses of a salt which is the *allophanate of baryta*, while the liquid holds alcohol in solution. This salt has an alkaline reaction, and is sparingly soluble in water; when its solution is heated, it is decomposed below 212° F.; all the baryta is deposited in the form of a carbonate, while at the same time carbonic acid is disengaged with effervescence, and the liquid contains nothing but pure urea.

* Compt. Rendus de l'Acad, t. xx, p. 1587, et t. xxiii, p. 811.

By a dry distillation, it evolves carbonate of ammonia ($CO_2\,2NH_3$), without a trace of water, and a residue of fused cyanate of baryta remains. By the action of acids it evolves pure carbonic acid gas, without the least odor of cyanic acid, and the liquid contains urea with but a trace of ammonia. Its solution does not immediately precipitate salts of silver or lead; but after some time, with the latter, it causes a precipitate of pure carbonate of lead.

When the baryta salt is triturated with a solution of sulphate of soda, the *allophanate of soda* is formed, which is separated in small prisms on the addition of alcohol. The same salt is obtained when the cyanic ether is dissolved in an alcoholic solution of soda. By the action of nitric acid, it is decomposed, evolving pure carbonic acid gas, and depositing crystals of nitrate of urea.

The analyses of the baryta salt correspond perfectly with the formula ($C_4\,H_6\,N_4\,O_5$, Ba O), or in Gerhardt's notation ($C_2\,H_3\,Ba\,N_2\,O_3$); the normal species, allophanic acid will then be ($C_2\,H_4\,N_2\,O_3$.) It contains the elements of two equivalents of cyanic acid and one of water ($2CHNO+H_2\,O$); and, as M. Gerhardt remarks, corresponds to the genus *thiocarbamate* $C_2\,H_4\,N_2\,S_2$ (hydrosulphuretted hydrosulphocyanic acid of Zeise), produced by the action of ammonia upon sulphuret of carbon.

MM. Liebig and Wöhler have also studied the action of cyanic acid on aldehyde. When the cyanic vapors are passed into dry aldehyde surrounded by ice, the liquid enters into ebullition, evolves carbonic acid gas, and is gradually changed into a tough mass resembling in appearance calcined borax. This product contains cyamelid, aldehydate of ammonia, and a new acid which the authors have called the *trigenic acid*. It is prepared by boiling the mass in hydrochloric acid, so long as vapors of aldehyde are evolved; the liquid is then filtered, and on cooling deposits the new acid in small prisms, sparingly soluble both in alcohol and water.

The trigenic acid fuses by heat and then carbonizes, emitting alkaline vapors which have the odor of *quinoleine*, and some reactions which the authors have obtained with the condensed products, have induced them to conclude that this alkaloid is really formed; cyanuric acid is evolved at the same time.

Analysis gives, for the composition of this acid, the formula ($C_8\,H_{12}\,N_6\,O_3$, $H_2\,O$), in the notation of the English chemists, ($C_8\,H_6\,N_3\,O_3$, HO), or according to Gerhardt, ($C_4\,H_7\,N_3\,O_2$).

When its solution is mixed with ammonia, it yields, with nitrate of silver, a precipitate of *trigenate of silver* ($C_4\,H_6\,AgN_3\,O_2$); this is decomposed by heat, blackening, and evolving vapors which have an odor of quinoleine.

Acetone appears to be acted upon by the cyanic vapors, in a manner similar to alcohol and aldehyde, but the products of the action have not yet been examined. T. S. H.

8. *On the Preparation of Crystallized Bile;* by M. Plattner, (Compt. Rendus des Trav. de Chem., Aug., 1847, from Jour. für Pract. Chem., t. xl, p. 129.)—The author claims the priority of this discovery, recently announced by M. Verdeil. The method of M. Plattner which was described in 1845, is as follows. The bile previously dried in a

water bath, is dissolved in hot absolute alcohol; the mixture is set aside to cool, and after being heated again, ether is added by small portions with continual agitation until a brown unctuous matter begins to separate; the vessel is then stopped and put aside for several days. A semi-fluid substance subsides and the liquid above becomes quite limpid and nearly colorless. This is decanted into a very dry glass and exposed to an intense cold for several days; if it still deposits an amorphous matter, it is necessary to decant it anew. If the cold is sufficiently great, the liquid now deposits pure colorless crystals of *bilate of soda* entirely free from marine salt.

Analysis gives for their composition,

| | | | |
|---|---|---|---|
| Carbon, | 59·1 | | 59·1 |
| Hydrogen, | 8·8 | | 8·9 |
| Nitrogen, | 1·4 | | |
| Sulphur, | not determined. | | |
| Oxygen, | 25·5 | | |
| Soda, | 5·2 | | 5·3 |

M. Plattner remarks, that Vogel, in 1812, showed the existence of sulphur in the bile. T. S. H.

9. *Test for Strychnine*, (Compt. Rend. des Trav., &c., Aug., 1847, from Jour. für Pract. Chem., t. xxxviii, p. 511.)—M. Otto employs bichromate of potash in place of the peroxyd of lead proposed by M. Marchand. This salt added to a solution of strychnine in sulphuric acid, produces immediately a beautiful violet color much more brilliant than with the peroxyd. T. S. H.

10. *New Methods of separating Nickel and Cobalt.*—(1.) Method, by H. Rose, (Royal Acad., Berlin, June 14, 1847, L'Institut, No. 727.)—The mode of separation proposed by Mr. Rose for these two metals, rests on the fact that in a solution of oxyd of cobalt which contains free hydrochloric acid, this metal may, by means of chlorine, be wholly transformed into perchlorid, while the chlorid of nickel suffers no such change in an acid liquid. To employ this means of separation, the two metals are dissolved in a decided excess of hydrochloric acid; the solution is then largely diluted with water, and a current of chlorine gas is passed through it for several hours until the liquid is completely saturated therewith. Carbonate of baryta is then added in excess, and the solution left for twelve or eighteen hours in a cool place and frequently agitated. The peroxyd of cobalt which is precipitated with the excess of carbonate of baryta is washed with cold water, dissolved in chlorohydric acid, and after removal of all the baryta by sulphuric acid, the oxyd of cobalt is precipitated by solution of potash, and after washing and drying is reduced in a platinum or porcelain crucible by means of hydrogen. The filtrate from which the cobalt has been separated is of a pure green color, and is perfectly free from any traces of oxyd of cobalt. After separating the excess of baryta from this filtrate the nickel is thrown down by a solution of potash. This method can be advantageously employed in preparing these two metals in a perfectly pure form.

(2.) Method, by Liebig, (extract from a letter from Baron Liebig to Prof. Horsford of Cambridge; communicated for this Journal.)—

"The two oxyds are covered with prussic acid and then potassa is added till both are dissolved. The solution is then kept boiling through a quarter of an hour. At the conclusion of the boiling, moist hydrated oxyd of mercury is added to the hot solution till a part remains undissolved. There occurs a green precipitate containing all the nickel, with an excess of undissolved oxyd of mercury. By ignition there remains pure oxyd of nickel.

Acetic acid is added to the filtrate till the reaction is acid and then thrown down with blue vitriol. The blue precipitate contains all the cobalt. This is dried, ignited, redissolved in hydrochloric acid, the copper precipitated by hydrosulphuric acid, and then from the filtrate, the cobalt with potassa.

The method depends upon the fact that nickel-cyanid of potassium is decomposed by oxyd of mercury, while cobalto-cyanid of potassium experiences no change.

11. *M. Ebelman on Artificial Hyalite and Hydrophane*, (Academy of Sciences, Dec. 4, 1847, L'Institut, No. 727.)—About two years since, Ebelman presented to the French Academy, several products obtained by exposing silicic ether to moist air: one of these is as transparent and colorless as quartz crystal; the others have an opaline tint, but in water they become as transparent as native hydrophane. The specimens now presented were of much larger dimensions, and are in the form of hemispherical lenses obtained in glass globes; they have remained entire, notwithstanding the considerable shrinkage which they have suffered. One of these lens-shaped masses is five or six centimetres in diameter; it has hardened during five or six months, and the molecular movement in it has not yet ceased.

In mixing silicic ether with colored alcoholic solutions, various tints of color are imparted to the product. One of the most remarkable of these effects is from the employment of chlorid of gold, which colors the silica of a beautiful topaz yellow. After a time and under the influence of diffuse light, flakes of gold with the metallic lustre and brilliancy are developed in the midst of the solid mass giving it the appearance of aventurine. This development of metallic plates in the midst of a solid mass is a very remarkable molecular phenomenon, the study of which cannot fail to be of interest in explaining the origin of natural aventurine. Exposure to the direct light of the sun, colors the aventurine of chlorid of gold, of a blue violet or rose color, remaining quite transparent. Thus by the humid mode we can reproduce the rose color which is imparted by the dry mode to glass by gold. When the crystals of gold produced in the midst of the siliceous mass are very numerous, a green color can be observed in it by transmitted light.

The diaphanous silica obtained by silicic ether may be compared to the hyalite of mineralogists, which possesses no double refraction. Hyalite is much harder, and the amount of water it contains does not exceed $\frac{1}{100}$, whilst the product obtained by M. Ebelman contains 22 per centum of water. The artificial product, however, continues for a long time to lose water under the influence of a very gentle molecular change. The author has observed that after more than two years exposure to air the product contains not more than 19 per cent. of water. Dried at 115° C., the diaphanous silica loses its water and becomes

slightly opaline. It regains several centimes of this water by further exposure at the common temperature but without recovering its transparency.

12. *On the Products of the decomposition of Cuminate of Ammonia by Heat;* by Mr. FRED. FIELD, (Phil. Mag., Dec., 1847.)—On subjecting this salt to a heat sufficient to keep it in a semi-fluid state, *cuminamid* is obtained, being an amid analogous to oxamid. Its formula is $C_{20} H_{13} NO_2$, it crystallizes from a strong solution in brilliant tables, from a dilute solution in long opake needles—both forms having the same composition. It is indefinitely soluble in hot or cold alcohol or ether. Unlike most other amids, strong solutions of potash or mineral acids do not alter it, and long boiling scarcely produces the usual conversion into the ammoniacal salt.

By keeping the fused cuminate of ammonia in brisk ebullition, a light oil passes over with water, this is *cumonitrile* $C_{20} H_{11} N$, being formed from the last product by the elimination of two equivalents of water. Cumonitrile is a clear colorless liquid of high refractive power, agreeable odor and burning taste. Indefinitely soluble in alcohol and ether. Sp. gr. 0·765. Boiling point 462° Far.

Strong nitric acid acts upon this substance only after boiling, and regenerates cuminic acid. Heated with potassium, the presence of cyanogen is indicated.

Alcoholic solution of potash, after a long time, regenerates cuminamid, which it is to be remembered is with difficulty converted into cuminic acid and ammonia.

In like manner nitro-benzoate of ammonia was converted into nitrobenzamid, but the process is difficult as the salt explodes often with violence.

The formation of a sort of amid with the elimination of four equivalents of water by the author, seems to have been previous to, and without the knowledge of similar experiments of M. Dumas, noticed p. 263.

G. C. SCHAEFFER.

13. *On Nicotine;* by M. BARRAL, (Ann. de Chim. et de Phys., Aug., 1847.)—The author had proposed the formula $C_{10} H_8 N$—this was afterwards altered to $C_{10} H_7 N$, with the suggestion that it should be doubled. The salts being deliquescent, and the platinum and mercury salts leaving the question undecided, the author determined to take the density of its vapor as well as that of aniline, which closely resembles it. The density of the vapor of nicotine was 5·630 and 5·607. With these numbers, $C_{10} H_7 N$ give 2 vols. of vapor. The density of the vapor of aniline was 3·21, which gives for its formula $C_{10} H_7 N$, 4 vols. Nicotine estimated at 4 vols., therefore, must have its formula doubled and becomes $C_{20} H_{14} N_2$.

The author gives the following properties of nicotine. Sp. gr. at 59°, 1·027; at 212°, 100 parts dissolve 10·58 of sulphur, which nearly all separates on cooling. It absorbs from a moist atmosphere nearly twice its weight of water, which it loses over potash with a certain quantity of water; it solidifies at 0°, anhydrous nicotine does not. Chlorine reacts violently—the product has not been examined. G. C. S.

14. *A new Chlorine Compound from the Dutch Liquid;* by J. PIERRE, (Comptes Rendus, Sept., 1847.)—This substance is said to be obtained without difficulty by the action of chlorine upon the Dutch liquid. Its

composition is $C_4\ HCl_5$, and therefore completes the series of chlorine substitutions in $C_4\ H_4\ Cl_2$.

The reaction of alcoholic solution of potash is extremely violent and gives rise to chlorid of potassium and protochlorid of carbon, $C_4\ Cl_4$.

The properties of the new substances are as follows. It remains liquid at 32° Fah., and boils at 309° Fah. Sp. gr. at 32° is 1·66. Odor agreeable like that of honey. Taste sweet and burning, but less so than that of the Dutch liquid.

[It is to be remarked that the boiling point of this liquid is as much above that of the next chlorine compound, as that is above the boiling point of the one before, the difference being 20° cent.] G. C. S.

15. *On Cochineal;* by WARREN DE LA RUE, (Phil. Mag., Dec., 1847, and Supple.)—It has been stated by Beissen that hydrosulphuric acid would decolorize the coloring matter of cochineal. This, M. De la Rue has found to be a mistake. A very complete examination has satisfied him that carmine is in reality an acid, for which he proposes the name of *carminic acid*.

It was at first found difficult to prepare this substance in purity—the impurity consisting of phosphoric acid and a nitrogenous substance. The following process is recommended. Precipitate the aqueous decoction by acetate of lead, decompose the washed carminate of lead by hydrosulphuric acid. Repeat this, adding acetic acid to the acetate, evaporate to dryness, redissolve in absolute alcohol, digest with some carminate of lead, precipitate the nitrogenous matter by ether, the filtrate yields pure carminic acid.

This substance is purple brown in mass, rich red in powder, very soluble in water and alcohol, slightly so in ether. Strong sulphuric and hydrochloric acids dissolve it without decomposition.

The composition of carminic acid is $C_{28}\ H_{14}\ O_{16}$, its acid character is but feeble and no salts were prepared, save one, with copper.

The action of nitric acid is violent and a new acid is formed, called by the author the *nitrococcusic*. Its properties are similar to the other acids obtained by nitric acid. The composition is $C_{16}\ H_5\ N_3\ O_{18}$, the salts, of which several were formed, are $C_{16}\ H_3\ (M_2)\ N_3\ O_{18}$. G. C. S.

16. *On the Conductility of Heat by Crystallized Bodies;* by M. DE SENARMONT, (2nd Memoir in Comptes Rendus, Nov. 15, 1847, p. 708.)—In this memoir the author establishes the following propositions, which correspond in their general character with analogous principles relating to the propagation of light by crystals.

1. In crystals of the regular system (monometric or tesseral) the conductility is alike in all directions, and the isothermal surfaces are spherical surfaces concentric to the source of heat.

2. In crystals of the square prismatic system (dimetric) and in those of the rhombohedral system, the conductility is alike in all directions at right angles with the vertical axis; and isothermal surfaces are concentric ellipses of revolution, oblong or prolate, concentric to the source of heat and revolving about the axis of symmetry.

3. In crystals of the right rectangular prism (the trimetric system) the conductility differs in three directions, or has three principal values following rectangular directions parallel to the edges of the prism, and the isothermal surfaces are concentric ellipsoids, not of revolution, and whose three axis correspond to the edges.

4. In the oblique rhombic and right rhomboidal prisms (monoclinate or monoclinometric system) the conductility has three values; one of which corresponds to that lateral crystallographic axis which is at right angles with the vertical; and the others are in the plane at right angles with this one, and at right angles with one another, but follow certain resultant directions not à priori distinguishable. The isothermal surfaces are ellipsoids not of revolution, in which only one of the three axes has a position determinable à priori.

5. In the oblique rhomboidal prism (triclinate or triclinometric). The conductility has three values, probably in three rectangular directions, not à priori assignable, because this form has no line of symmetry.

Although the laws of the propagation of light are closely similar, there is not a perfect identity. In the rhombohedral system, calc spar has a very strong double refraction, quartz a very feeble; yet the ellipticity of the isothermal curves is less for the first than for the second The optical effects in these two substances are of a contrary kind, one having a positive and the other a negative axis; yet the isothermal axis is oblong in both.

Senarmont's memoir has been reported upon by Biot, Beudant and Regnault, to the Academy of Sciences at Paris, who speak in the highest terms of his mode of experimenting and of the value to be attached to his results.

17. *On the motions of Fluids in Animal Bodies*, (extract from a letter from Baron Liebig to Prof. Horsford of Cambridge, dated Nov. 5, 1847; communicated for this Journal.)—"In my letter of Sept. 14, I have communicated the principal results of an investigation upon endosmosis, which I have now brought to a close. I have been led to several very interesting conclusions in relation to the motion of fluids in the animal body, occurring without the blood vessels; but I cheerfully maintain that the worthy old Hales might have made all my deductions from his own individual investigations.

I have, in the first place, found that an animal membrane in a dried condition, under the pressure of the atmosphere is impermeable to air. When the tube, fig. 1, is bound at *a* with a membrane (bladder), then dried, filled with mercury, and inverted in the cup *b* in mercury, the quicksilver falls to 27–27½ inches, and there remains through many days. The mercury would remain at 28 inches* if it were possible without boiling to expel the air from it. We have in this an actual barometer, one of the ends of which is animal membrane.

Fig. 1.

If the same tube be filled with water instead of mercury, and placed in a vessel containing mercury, the latter will rise gradually in the tube; with ox-bladder the mercury rises to 22 inches without the slightest introduction of air. The reason of this ascent may be readily seen. The water that permeates the moist membrane evaporates from the outside of the bladder. It escapes in the form of vapor. Water presses after this, which again evaporates, and in this way there is produced a vacuum in the

* The normal elevation.

tube into which the quicksilver rises in obedience to atmospheric pressure. For each membrane the mercury rises to a certain point, which is lower in proportion as the membrane is thinner. This point is the limit of pressure by which air passes through the pores of the membrane. When the mercury in the tube has reached its maximum elevation, and remains for example in fig. 2 at *d*, if the part *a* be placed in a vessel of water, the latter is pressed readily through the membrane, and the mercury falls for example, to *b*.

Fig. 2.

It follows herefrom, that water may be forced through the pores of a membrane at a much lower pressure than air. And hence the following experiment may be readily explained. When a glass tube, bent as in Fig. 3, is filled with water and closed at both extremes with membrane, (this is most easily arranged under water,) and the one extremity exposed to evaporation, while the other is immersed in solution of salt, or gall, or sugar, the vessel will gradually become exhausted of its liquid, and the tube will become filled. This is, as you know, the opposite of that which takes place in endosmosis. By that process pure water would go to salt-water; but here where evaporation takes place, the salt-water passes into the tube to pure water. But it is not only salt-water, but oil goes under these circumstances with readiness through the bladder, and fills the tube in process of time completely with it.

Fig. 3.

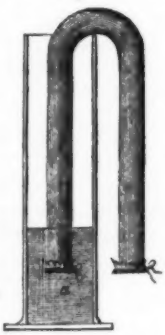

Fig. 4.

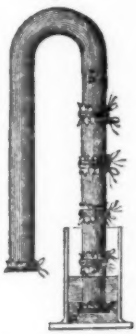

Fig. 4 exhibits an apparatus where the fluid passes from the vessel *a* into the tube *b* through nine membranes. (They are bits of tube closed with membranes, and connected through India rubber with the elbow *b*.)

The employment of these results upon the processes in the animal body, scarcely requires a more detailed explanation.

The surface of the body is the membrane, from which evaporation goes constantly forward. In consequence of this evaporation, all the fluids of the body, in obedience to atmospheric pressure, experience motion in the direction toward the evaporating surface. This is obviously the chief cause of the passage of the nutritious fluids through the walls of the blood-vessels, and the cause of their distribution through the body. We know now what important functions the skin (and lungs) fulfill through evaporation. It is a condition of nutrition, and the influence of a moist or dry air upon the health of the body, or of mechanical agitation by walking or running, which increase the perspiration, suggests itself." * * * *

18. *On Oxgall;* (extract from a letter from Baron LIEBIG to Prof. HORSFORD, bearing date of Dec. 17, 1847; and also of a letter from M. STRECKER, dated Nov. 5; communicated for this Journal.) * * * * —"Dr. Strecker has at my suggestion resumed the investigation of oxgall, and through his labors glycocoll has gained a new and important character. It appears that the gall may be considered a compound of a body free from nitrogen with glycocoll and taurin, by which two paired acids are formed, and which united with soda (potash and ammonia), constitute the gall. One of these acids is glyco-cholic acid (the old cholic acid of Gmelin); the other is tauro-cholic acid (Demarcay's choleic acid.) The gall consists, one-third of it, of alkaline glycocholates.

A good method for the preparation of this acid, is to precipitate common impure oxgall just as it flows from the bladder, with sugar of lead; wash and dry the precipitate, and then extract with alcohol. The alcoholic solution of this lead precipitate must be decomposed with hydro-sulphuric acid, filtered, and the precipitate of sulphid of lead washed with warm water, the filtrate running into the alcoholic solution until it is rendered turbid. The whole remains then quiet, and after twelve hours, the fluid stiffens to a viscid mass consisting of white fine needles, which are pure glycocholic acid.

If glycocholic acid is boiled with baryta, it decomposes into glycocoll and a beautifully crystalline acid, the cholalic acid, which is identical with Demarcay's cholic acid. If glycocholic acid be treated with hydrochloric acid, it falls apart into glycocholic and choloidinic acid. If the boiling continues too long, the choloidinic acid goes into dyslisin.

These changes may be explained in a very simple manner.

| | |
|---|---|
| Glycocholic acid is . . . | $C_{52}\,H_{43}\,NO_{12}$ |
| Take Cholalic " " . . . | $C_{48}\,H_{40}\,NO_{10}$ |
| and there remains, . . . | $C_4\ H_3\ NO_2$ |
| Add . . . . . | $H_2\ O_2$ |
| and we have glycocoll, . . | $C_4\ H_5\ NO_4$ |
| Cholalic acid is . . . . | $C_{48}\,H_{40}\,O_{10}$ |
| Choloidine " " . . . . | $C_{48}\,H_{39}\,O_9$ |
| Dyslisin is . . . . . | $C_{48}\,H_{36}\,O_6$ |

These acids differ only in the elements of water.

NOTE.—We are here reminded of the relationships which glycocoll sustains to hippuric acid. Benzoic acid is there separated by treatment either with baryta or hydrochloric acid.

$$\overbrace{C_{18}\,H_9\,NO_6}^{\text{Hippuric acid.}} + Ba\,O = \overbrace{C_4\,H_4\,NO_3}^{\text{Glycocoll.}},\,HO + Ba\,O,\,\overbrace{C_{14}\,H_5\,O_3}^{\text{Benzoic acid.}}.$$

or,

$$\overbrace{C_{18}\,H_9\,NO_6}^{\text{Hippuric acid.}} + HCl + 2HO = \overbrace{C_4\,H_4\,NO_3}^{\text{Glycocoll.}},\,HCl,\,HO + C_4\,H_5\,O_3."$$

M. Strecker in his letter observes:—"I have been at work through the summer upon oxgall, and have obtained exceedingly interesting results, though the investigation is by no means closed. The gall con-

tains the soda salt of a nitrogenous but non-sulphurous acid, which is nothing else than Gmelin's cholic acid, and may be obtained in a crystalline form. It is most readily prepared from crystallized gall, by precipitation with sulphuric acid and addition of ether, whereupon it crystallizes in fine needles.

Its formula is, $C_{52}H_{42}NO_{11}+HO$.

Besides this acid, there is also a body containing sulphur in the gall, with which I am still occupied."

19. *On the Analysis of Chromic Iron;* by T. S. Hunt, (communicated for this Journal.)—This species is well known to be most difficult of decomposition by the processes generally employed, which consist in fusing it with a mixture of nitre and hydrate of potash or an alkaline carbonate. In these, however finely the ore is pulverized, a portion almost invariably escapes decomposition. To obtain the mineral in a state of minute division, Fresenius recommends elutriation, and directs that after fusion with nitre and carbonate of soda, the portion insoluble in water be digested with hydrochloric acid, and the amount of undecomposed ore be deducted from the original quantity.

This may serve for the analysis of pure homogeneous specimens, but the common varieties are generally more or less mixed with foreign substances and often with silicates of alumina and magnesia which are lighter than the ore; in the process of elutriation consequently, the portion of finely divided ore obtained suspended in the water, will contain a larger proportion of the impurities than that which remains at the bottom of the vessel. Again, when the powder thus obtained is fused with an alkaline carbonate, the silicates are at once attached while the portion which remains to be deducted after the action of both alkalies and acid, is pure chromic iron. In this way a specimen of impure ore will give a per-centage of oxyd of chromium considerably below the truth.

While endeavoring to find some more eligible mode of treatment, it occurred to me that the bisulphate of potash might be used with advantage, and in this I was not disappointed; for I found that with certain precautions, the mineral might be completely decomposed by it. The chromic iron must first be very finely levigated; (a gramme of the crushed ore will require fifteen or twenty minutes trituration in an agate mortar;) it is then to be mixed with ten or twelve times its weight of fused bisulphate of potash and the mixture heated to fusion in a platinum crucible and preserved at a gentle red heat for about thirty minutes. The crucible and its contents when cold, are placed in water which with the aid of heat soon dissolves the saline mass. The greater part of the chromium is left as a green basic sulphate, insoluble in water or hydrochloric acid, and apparently identical with that obtained when any salts of chromium are heated with an excess of strong sulphuric acid.

I have found it the best mode of treating this mixture of soluble and insoluble salts, to boil the whole for a few minutes with an excess of carbonate of potash or soda which precipitates the alumina, iron, chromium, that may be in solution, and decomposes the insoluble sulphate; it is not easy, however, in this way to remove all the sulphuric acid, and thus render the residue quite soluble in hydrochloric acid, but this

is of no importance. The dried precipitate is now to be treated after the process recommended by Fresenius, which consists in fusing it with five times its weight of a mixture of equal parts of nitre and carbonate of soda. The operation should be performed in a platinum or preferably a silver crucible over a spirit lamp, and the mixture kept in fusion ten or fifteen minutes to ensure the perfect solution of the chromium. The chromate of potash is then dissolved out from the mixture of oxyd of iron, alumina and magnesia which may be separated in the ordinary manner; if the precautions above mentioned have been observed, no trace of undecomposed ore will be left after treating the mixture with hydrochloric acid. A small portion of magnesia remains, dissolved in the filtrate from the precipitate by carbonate of soda, and may be obtained by evaporating to dryness. Any silica which the mineral contained is also dissolved, and may be separated in the usual manner.

The presence of a small portion of sulphates prevents the determination of the chromic acid by a salt of lead; we, accordingly, supersaturate the solution with hydrochloric acid and boil with alcohol to convert it into chlorid of chromium, from which the oxyd is to be precipitated by adding ammonia in excess and boiling for a few minutes.

I have employed this method several times with perfect success: it is easy of execution, and being free from any sources of error, yields very accurate results.

Montreal, March 25, 1848.

## II. Mineralogy and Geology.

1. *On the Structure and Teratology of Crystallized Bodies;* by M. A. Baudrimont, (Comptes Rendus, Nov. 8, 1847, p. 668.)—M. Baudrimont gives the following table of observations made by him on the cleavage of calc spar. It is interesting as showing, that while the fact that the vertical axis is normally an axis of symmetry is demonstrated by the crystallization, and by optical, thermometric, and acoustic investigations, still extrinsic circumstances cause some variations from perfect symmetry in the cleavage.* The cleavages observed are as follows:—

1. Parallel to the faces of the primary rhombohedron.
2. Parallel to the longer diagonal of the primary faces.
3. Parallel to the shorter diagonal of the primary faces.
4. Parallel to different secondary planes.

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Irised appearances and colored bands are produced by this kind of cleavage. In all cases images are polarized in directions parallel to the diagonals of the faces of the rhombohedron.

3. Cleavage parallel to the smaller diagonal of the primary faces.

In one direction. *Very rare.* Produces a species of colored rings.

M. Baudrimont gives details showing also that the lustre and transparency vary like the cleavage, and that the plane angles at the summit are often unequal.

2. *On Different Crystals and Fluids in Topaz;* by Sir DAVID BREWSTER, (Trans. Roy. Soc., xvi, 11; Phil. Mag., xxxi, 497.)—This valuable memoir by Sir David Brewster may be considered a continuation of two former papers of his, communicated in 1823 and 1826 to the Royal Society of Edinburgh. In these earlier papers, he described two remarkable fluids occurring in topaz and other minerals. In the recent memoir a peculiar gaseous substance is described (in addition to the fluids before discovered), and also, at least, five distinct crystallized substances.

The cavities are at times isolated, but often exist in millions in extensive layers; and the layers, though sometimes conforming in position to the primary or secondary planes, often have every possible direction, and present every variety of curvature, with the most irregular outlines. Moreover, they are sometimes in concentric arches; and sometimes in radiations; and different layers, though very close to one another, have striking differences of character.

The crystals observed have the following forms, the tetrahedron; the cube; cube with truncated edges and angles; the rhombohedron; hexagonal plates; prism with plain and pyramidal summits; flat octahedron, truncated on its edges and angles; long rectangular plates. Besides these, there are amorphous crystallized masses. He observes:—

"In the examination of the individual crystals, many interesting facts present themselves to our notice. The crystals of the tessular class, which are modifications of the cube, are very numerous, and have no action upon polarized light. Many of them melt easily, while others refuse to yield to the action of heat; and hence there must be two different substances in the cavities which assume the same shape. In like manner, some of the doubly refracting crystals melt readily, others with very great difficulty, and others not at all; so that there must be *three* different substances, which belong to the classes of forms that give double refraction; a conclusion which is confirmed by the different secondary forms which I have already enumerated.

"I have seldom found any crystals in these cavities which depolarize white light, or the highest order of colors. I have found some that depolarize *four* orders of colors; and when the crystal which does this is a flat hexagonal plate, it is highly interesting to see it pass through all the tints which these orders include, while slowly melting, and again reproducing them during its recrystallization.

"In a cavity which was so placed as to be entirely black from the total reflexion of the light which fell upon it, I observed three *white* openings. These appeared to be fixed crystals, or rather parts of the topaz, surrounded by a cavity. I found, however, that the hexagonal

one depolarized white light, while the rest had no action upon polarized light. Upon applying heat, the crystal melted, and took another position in a narrower part of the cavity, where it remained of an irregular form, having been repeatedly melted and recrystallized. Upon turning the cavity into a position where it became transparent, I found that there was no fluid whatever in the cavity; so that we have here an example of a crystal melting and recrystallizing without having been dissolved in one of the fluids. From the irregular state of the laminæ close to this cavity, there is every appearance of the fluids having escaped from one of its extremities."

In several instances a crystal was seen to have a rapid rotation through some cause beyond explanation. Speaking of one cavity, it is remarked, that a part of it, when first submitted to the microscope, contained five small crystals; one, a flat prism, another a hexagonal plate; a third amorphous; and a fourth and fifth, two irregular halves of a hexagon. Upon the first application of heat, one or two of these crystals leapt from their resting place, and darted to the opposite side of the cavity. In a few seconds the others quitted their places one after another, performing the most rapid and extraordinary rotations. One crystal joined another, and at last, four of them thus united, revolved with such rapidity, as completely to efface their respective shapes. When too much heat was applied, the crystal often burst with an explosion. These substances have not yet been chemically examined. He says:—

"The only chemical experiment on the contents of these cavities, which I have had occasion recently to make, is perhaps worth reporting. One angle of a cavity was blown off by its explosion, and though the fluids escaped, a pretty large prismatic crystal remained within the cavity. I introduced *water* and *alcohol* successively into the cavity, and raised them to a considerable heat; but they had no effect in dissolving the crystal."

3. *Kraurite and Cacoxene in Tennessee;* by G. Troost.—These minerals occur near Brush Creek, which runs into the French Broad River in Cocke county, Tennessee. The kraurite occurs in botryoidal concretions lining cavities, or in small masses imbedded, or in small veins, in a manganiferous brown iron stone (hydroxyd of iron), intermixed with stilpnosiderite and pitchy iron ore (iron sinter).

The botryoidal kraurite is externally of a deep olive or leek green color; in its transverse fracture, the green color is not so deep, exhibiting zones of different shades of green, passing into greenish white or greenish yellow of several shades from brownish to bright yellow.

Its structure is fibro-radiating; this fibrous structure, in proportion as it deviates from the centre, assumes an asbestiform appearance; this is generally the case with the yellow variety, and it resembles then the cacoxene, not only in appearance, but also before the blowpipe. In fact these two minerals seem to pass the one into the other, in proportion as the alumina or iron prevails. A delicate silky variety of a yellow color, forms also small veins through the matrix.

It is associated with Wavelite, (?) which nevertheless is only dispersed in a few small particles through the iron ore.

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4. *Columbite from near Limoges, France;* by A. DAMOUR, (Comptes Rendus, Nov., 1847.)—Specimens from this new locality, have a tarnished bluish black color, and a density 7·651. Composition—columbic acid 82·98, oxyd of tin 1·21, oxyd of iron 14·62, oxyd of manganese, *a trace*, silica 0·42 = 99·23. It occurs in a yellowish white feldspar, in a quarry near Chanteloub.

5. *On the Composition of Urano-tantalite and Columbite* (Phil. Mag., Jan., 1848, p. 77; Journ. de Ch. et de Phys., Nov., 1847.)—According to a notice published in the *Comptes Rendus Mensuels de l'Académie de Berlin*, Avril, 1847, p. 131, by M. Henri Rose, the yttro-ilmenite of M. Hermann is merely the urano-tantalite described by M. Gustave Rose. M. Henri Rose has satisfied himself of their identity, by means of some specimens of yttro-ilmenite which had been sent him; his new experiments confirm his first results; and he has found it impossible to extract any ilmenic acid from the mineral in question, which he considers to be merely niobic acid, mixed with a certain quantity of tungstic acid.

As the urano-tantalite (the yttro-ilmenite of M. Hermann) contains no columbium, M. Henri Rose proposes to give it a new name, that of *Samarskite*, in honor of M. Samarski, Director of the Mines of Siberia.

This mineral contains a little yttria and protoxyd of manganese, besides niobic and tungstic acids, oxyd of uranium, and protoxyd of iron.

Many of the specimens of samarskite are mixed with columbite, the crystalline form of which is such as it has been described by M. Hermann.

The columbite of Siberia has been examined by M. Th. Bromeis: the acid which it contains is niobic acid nearly pure, with mere traces of pelopic and tungstic acids.

6. *New Volcano*, (Athenæum, No. 1054, Jan. 8, 1848.)—A new volcano is stated to have broken out at Amargura, an island in the Pacific, in the Friendly group, east of Vavau about twenty miles. On the 9th of July and two following days, violent shocks of an earthquake were felt at intervals of fifteen or twenty minutes, at Vavau, and other phenomena of a volcanic eruption have been observed. Mr. Williams, on nearing the island on the 13th, observed a little above the sea-level, a vast crater from which boiling lava issued in torrents and spread over the neighboring plains. But such was the violence of the action, that he was obliged to return without having ascertained the fate of the unfortunate inhabitants.

7. *Earthquakes and Eruption in Ternate*, (Jour. Ind. Archipel., No. 3, Sept., 1847, p. 168; from the Javasche Courant for August, 1847.)—On the 21st December last, three shocks of an earthquake were felt in Ternate, the first two of which were very heavy and accompanied by a thundering noise.

On the 7th of February following, the inhabitants of this island were again disturbed by an eruption of the mountain, which lasted about half an hour. The obscure light prevented any other phenomena of this eruption being noticed, save the thundering noise with which it was attended, and the column of ashes which it ejected above the clouds. The lava stream flowed to the north of the mountain, without causing any damage.

Two other earthquake shocks were subsequently experienced at Ternate; while, finally, on the 8th of April last, about half past 3 o'clock, a severe earthquake took place, which was felt in a direction from north to south, and lasted some seconds, without however occasioning any injury to buildings.

8. *Falling in of a Mountain in Timor*, (Jour. Ind. Archipel., No. 3, Sept., 1847, p. 168; from the Javasche Courant for August, 1847.) —In the month of March last, a sinking of the mountain Nimbenok (which is three days distance from Kupang) took place, in consequence of which many houses with their contents were destroyed by the great stones that rolled down. Fortunately no men were killed.

9. *On the Volcanic Plateaux of the Lower Caucasus;* by Prof. ABICH, (Imp. Sci. de St. Pétersbourg, extracted from the Quart. Journ. of the Geol. Soc., No. 11, Aug. 1, 1847.)—Prof. Abich, after laying down the division of *upper* and *lower* Caucasus, and limiting the latter term on geognostic grounds to the mountain district which is comprised in the almost elliptical space enclosed by the Araxes on the one side and by the Kur on the other, thus proceeds:—

*The Lower Caucasus.*—It is remarkable that this lofty mountain chain, so richly provided with every variety of physical productions, with its lofty summits 12,000 feet above the sea, should be below the limits of perpetual snow, while the summits of the Elburuz and the Kasbek, at a height of 10,380 and 9950 French feet, are above it. The principal ranges of this mountain chain are parallel with those of the upper and real Caucasus. Along a line which may be said to represent the principal portion of this mountain chain, it is traversed by a succession of table-lands connected with one another, having a considerable, though not always the same mean elevation above the sea. The rocks of which they consist have been brought to the surface of the earth in an igneous or molten state. These volcanic masses burst forth in the centre of those mountains, the heights of which they now cover, as with a mantle, with undulating nearly horizontal beds of extraordinary extent and thickness. They were elevated by the same forces which have caused the many regularly-formed conical hills, crowning the tops of those remarkable table-lands for an extent of fifty-four geographical (German) miles, at longer or shorter intervals, and which contribute so much to the landscape charms of the Armenian highlands. With this peculiar natural condition of closely connected volcanic table-lands, apparently universally repeated in the more western mountain districts of Asia Minor, are connected certain conditions of climate and of a physical character, which have exercised a considerable influence on the habits and development of the people of these regions.

The liability to decomposition of these volcanic crystalline rocks, which, like dolerite and trachyte, produce such a favorable soil for the vegetation of grasses and cerealia, acting on these table-lands, which for the most part are above the limits of the growth of trees in these regions (which in the Lower Caucasus may be reckoned at from 7000 to 7800 French feet), has principally called into existence those boundless alpine meadows, on which the existence of the Nomadic tribes of Asia Minor mainly depends. Whilst the horizontality of the

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connected uplands favors the equal distribution and collection of the snows of winter, the porous nature of the rock itself is the principal cause, that on this substratum a much smaller proportion of the melted waters returns by evaporation into the atmosphere, than is the case on steeper mountain heights, consisting of a more compact rock, and having either no soil, or only a very thin covering. Hence the production and origin of those numerous and peculiar sources to which the name of Karasu waters has been applied;* and this term has so far the merit of physical distinction, as by it all springs rising in lofty uplands, elevated by volcanic action, can be distinguished from such as rise out of other formations. Everywhere do these Karasu springs rise with an astonishing abundance of water, partly at the edges of the volcanic table-lands, even at the greatest heights, and partly immediately amidst and below the beds of lava which stretch down from the mountains into the open valleys. * * * *

Within the central region of the great volcanic range are to be found the greatest heights of the Lower Caucasus. There we have, as an isolated and independent system, the imposing and extensive mountain of Alaghéz, the base of which is 170 werstst in circumference; it is a phenomenon as peculiar as it is remarkable, in which the laws of craters of elevation are most fully borne out, and affords an amount of facts of the greatest importance for the doctrine of mountain chains. The uplands which exist on the summit of the flat dome of Alaghéz have, from a number of measurements from the best points, a mean elevation of 9970 French feet above the sea. Four pyramidal rocky points are placed with great regularity round the highest base of the excentrical *Caldera*.‡ The highest of them has, according to Fedorow's trigonometrical measurements, an absolute height of 12,886 French feet; and the lowest, towards the S.W., is by my barometrical measurements 866 French feet lower. The conditions of climate round the mountain are very different. Wheat scarcely ripens on the upland of Goeseldara,§ at the north foot of Alaghéz, 6343 French feet above the sea; whilst at its southern base, near Astarab, on the rocky banks of the Abarran, excellent wine is obtained at a height of 2462 French feet. On the southwestern declivities of the mountain, owing to the favorable influence of the neighboring plains covered by volcanic beds, the vine was formerly cultivated to a much greater height. Independently of historical report, this is proved in the environs of the remarkable fortress near the ruins of the old Armenian towns of Talyn and Eschnak, where the many deserted vineyards regularly arranged

* The word Karasu signifies *black water*, and is a term universally given throughout Asia Minor to a deep flowing-river in a mountainous district. I cannot quite adopt Prof. Abich's theory, as I have met with rivers called by that name in many parts of Asia Minor, where the nature of the country and the rocks preclude the idea of the term being derived from any cause like that alluded to in the text. Several rivers of this name are mentioned in my work on Asia Minor. —W. J. Hamilton, Geol. Soc. London.

† A werst is about two-thirds of an English mile.

‡ The point where the maximum of elevating power was exerted, causing the separation of the edges of the Caldera, is stated by the author in a long explanatory note, not to correspond with the central axis in the real summit of the whole dome, but to lie seven wersts to the northeast from the summit.

§ Ghieuzel-dereh, Fair Valley.

in terraces one above the other, with the vine-dressers' huts still in existence, are, according to my measurements, at an absolute height of 4254 French feet.

By means of uninterrupted volcanic deposits and a series of hills of various physical characters, the Alaghéz is in geological connexion with the lofty dome of the table-land of Agmangan, which is partly formed of eruptive matter of a doleritic nature. It stretches down in a S.W. direction opposite Mount Ararat, along the Goktschai (lake), and has a circumference of about 140 wersts. The level of the great crater-lake Kanly goell (Blood lake) gives the nearest average statement of the elevation of this flat dome, viz. 9278 French feet. The state of cultivation along the S.W. and S.E. sides of the Goktschai lake resembles that of the north of Europe; but on the S.W. of the Agmangan plateau, the lavas of the Naltapa and Agmangan extend into the district of the celebrated orchards of Erivan. The culminating points of the above mentioned flat dome are fixed—1st, by the magnificent erupted cone, of a vesicular character, of Agmangan, 11,160 French feet in height, where at the bottom of a moderately deep crater, is the most elevated lake in Armenia; 2d, further to the S.E. by the majestic crater of elevation of Agdag (Akdagh or White mountain), 11,480 French feet, and Bosdag (Grey mountain) or Altundag, 10,728 French feet above the sea.

These magnificent systems of trachytic porphyry are, in consequence of the predominance of certain vitreous modifications, mineralogically connected with the great obsidian mountains of Mexico. The high plain of Agridja, which forms the south-eastern prolongation of the Agmangan table-land, and is celebrated for its fertile meadows, leads by a gradual ascent to the flat ridge of the three volcanic systems which, closely connected together, complete the southern mountain barrier of the Goktschai. These are, 1st, the great crater of elevation, the Karanlysch dagh (Dark mountain), with its summit reaching to an elevation of 10,431 French feet; 2d, the Tik Pilakan (Steep Step), or Tasch Pilakan (Stone Step); and, 3d, the Goeseldara Baschi (head of the beautiful valley). The southern slopes of these fine mountains, the *Barancos* of which stretch down in parallel lines to the lake, keep up a direct communication by means of a gentle inclination with the lowest southern member of the vast chain of table-lands above mentioned. * * * *

On these, and in the exact direction of their longer axis, four great systems of volcanic eruption rise at almost equal intervals from one another. At a distance of 32 wersts from the south shore of the Goktschai, and 18 wersts from Tik Pilakan, the Carial or Kissil-tappa* begins the remarkable series. This extensive system consists of a group of rounded hills, from the centre of which rises a flat crater, and contains within its circumference the sources of the three great rivers, the Arpatschai, the Bazartschai, and the Terter, which flow from the Carial in opposite directions to the N.E. and S.W. It is still more remarkable in a geological point of view, that the two most important hot-springs of this great volcanic chain, occur in the bottoms of the

* Kizil Tepéh, or Red Hill.

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valleys of the Arpatschai and the Terter. The hot-spring in the Terter valley of 39° R. is 12 wersts distant from the Carial, at an absolute height of 6794 French feet; and the hot-spring of 29°·5 R., which gives the name of Istissudara* (warm-water valley) to the upper valley of the Arpatschai, rises at an absolute height of 6712 French feet, and at nearly the same distance from the Carial.

The system of the Baloglu or Dawagoesut is 14 wersts to the S.E. of the Carial; it is a similar group, with a flat erupted dome in the middle, still furrowed by the lava-streams which poured down its sides. Sixteen wersts beyond the Dawagoesu, is the extensive system of the Kizilboghasdag, with its broad crater called Maphrasch-tappa. The broadest lava-streams which, with their rough and stony surfaces, still cover a large portion of the table-land, have flowed from this crater. Finally, 16 wersts further rises the remarkable crater of elevation of the Klissalidagh, the last and greatest system of the whole series, with its remarkable mountain forms, the highest point of which, according to my measurements, is 9738 French feet above the sea. At the Klissalidagh commences the deposit of a tuff and trachytic conglomerate of vast thickness, by which the slope of the table-land is continued to the Araxes 73 wersts further. At the southern foot of the Klissalidagh, a broad valley, 962 feet deep, has been excavated in this tuff formation, where, at a distance of 15 wersts from the summit of the mountain, is Gürüs, the chief town of the district of Sangysur, on the river of the same name, at an elevation of 3900 feet, surrounded by the fantastic forms of pointed conical pillars of tuff, partly attached to the steep sides of the valley, and partly forming singular and isolated groups.‡

Now if we draw a straight line from the summit of the Klissalidagh at an angle of 58° W. of the meridian, and extend it to the Caspian and Black Seas, it will strike, at a distance of 176 wersts to the S.E., the summit of the Alaghéz. In this direction the line passes close to the extinct central volcano of the Daralaghéz called Dalychtappa,§ the crater of which has a circumference of 1960 paces, and an absolute height of 8042 French feet; it then strikes, at a distance of 75 wersts from its commencement, the already mentioned Karantychdagh, and subsequently in succession the volcanic cones Abul Hassar, 8596 feet high, on the upland of Agridja, with a crater-lake—the already mentioned Akdagh—the Scham Iram or Hadis, and the volcanic hill Kiotan-dagh, 7111 French feet above the sea, both the latter abounding in obsidian and pumice-stone, on the N.W. declivity of the Agmangan hills 20 wersts from Erivan. Lastly, the above mentioned line before reaching the Alaghéz also cuts through the Karnijerach, (Cracked-Belly). The construction of this flat mountain, which the Tartar language so expressively and figuratively describes, renders it an interesting modification of the craters of elevation in Armenia. The Karnijarach rises to an absolute height of 7913 French feet, commanding a stony and sterile tract of dolerite, 20 wersts above Erivan, 16 wersts in breadth and about 20 in length, between the rivers Sanga

* Properly Issi su dereh. † Deve ghieuz, or Camel's Eyes.

‡ Compare this with the remarkable hills described in Hamilton's Asia Minor, vol. ii, p. 250, in the valleys of Utch Hissar and Urgub.

§ Delik-tepéh (Hole-hill.)

and Abarran. The further extension of the line to the N.W., brings us to the great crater-lake of the Tschyldir group, with a surface of 116 square wersts, and resembling in a geological point of view the lakes of Bracciano and Montefiascone in the Papal States, and then over the summits of the great volcanic frontier mountains of the modern province of Achalzik, in the old country of the Lazes and the Chalybes. These mountains, which enclose the great source of cold of the Armenian highlands, and have been celebrated from the earliest time for their ungenial climate, are best observed from the heights of the Meski mountain chain, behind Abastuman. Amongst them, beginning from the S.E., the Dochuspungar, the Ardagandagh, the Arzian and Pozchowdagh, with their flat conical forms, are the most remarkable.

A straight line connecting the summits of the two Ararats, runs parallel with the above-mentioned line, deviating 58° W. from the meridian. Prolonged in the opposite direction (viz. S.E.), it strikes the isolated rock pyramids of the Takjaltu near Kulpi, and of the Yelanlidagh (Snake Mountain) near Nachitschewan. These two formations are mineralogically the same, and with a remarkable similarity of appearance, stand in an equally important geological relation to the great masses of rock-salt which are found in the mottled clays at both extremities of the valley of the Araxes. At a distance of 150 wersts N.W. from Mount Ararat, the above-mentioned line touches the summit of the Saganlu-dagh, the wooded volcanic mountain mass overlooking the plain of Kars.*

If in the same way we draw a line from the summit of the Kasbek at an angle of 66° 30′ W. of the meridian, it will at a distance of 176 wersts N.W., cut the summit of Elburuz, and to the S.E. at a distance 196 wersts, the Djultidag rising on the ridge of the Dagestan mountains above the limit of perpetual snow. This line however must be looked upon as representing the entire length of the whole Lower Caucasus.

The above-mentioned relations and connexions in the relative position of the principal summits of the mountain district of the Caucasus, are not merely accidental; they are important facts, which must be considered as the result of those internal laws which were alluded to at the commencement of this notice.

It was well known that volcanic forces had contributed to the elevation of the Caucasus in the same way as had been the case with regard to the Andes of South America; but the extraordinary share which volcanic action had exerted in modifying the surface of the mountain districts in the Southern Caucasus was neither known, nor even suspected. The geological period when these remarkable effects took place is, relatively speaking, very modern; its last appearances are clearly visible in the early dawn of the history of the human race. Throughout the whole extension of the Araxes plain up to the high plains of Schuragel and Kars, the upper sedimentary bed is a loose calcareous tuff, which is filled with the well-preserved shells of the same species of Mytilus which still inhabits the Caspian Sea.† This

* See Hamilton's Asia Minor, vol. i, p. 189.

† Ibid, vol. i, pp. 186 and 203.



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calcareous tuff is immediately covered by the lavas and other volcanic products which extend from the volcanic uplands to the plains, which are now respectively at the heights of 2400 and 4500 French feet above the level of the ocean.

Most remarkable is the difference of the results which elevating volcanic forces, and particularly eruptive volcanic action, which is still continuing, although with diminished intensity, on our planet, have produced in the development of the forms of the Upper and Lower Caucasus. In the former district they raised, by a great effort of power in a vertical direction, a lofty and continuous mountain wall 145 geographical miles in length, separating different quarters of the globe, and only passable in a few places; in the latter, heaving and eruptive forces were most effective, and the masses driven directly from the volcanic focus to the surface, were principally elevated and spread out in horizontal extent. From this difference is derived the greater variety and more favorable development of the natural features of the Lower Caucasus, and with this its ethnographical importance is most inseparably connected. W. J. H.

## III. Zoology.

1. *On certain principles bearing upon the Natural Classification of Animals, and more particularly on the Methodical Distribution of the Mammifera;* by M. Milne Edwards, (Ann. des Sci. Nat., 1844, t. i, p. 65.)—Milne Edwards, in this learned memoir, in which he gives in a connected form, the views elsewhere presented by him in detached parts, proceeds on the general principle that the fundamental relations of animals are best exhibited in the metamorphoses of species,—understanding by the term metamorphosis, the series of changes undergone by all animals in the progress of their development from the earliest condition in the egg to the adult state; a greater or less part of which, takes place in different animals within the egg state, and the rest after leaving it. In 1829, Milne Edwards brought out these views, with special reference to the metamorphoses of crustacea; and farther showed that crustacea have their closest resemblance to one another in their youngest age, and that the progress of development from the young up, tended to impress on the animal, characters that were more and more special and which removed them farther from the common type of the natural group to which they belonged. The same views, at the same period nearly, were independently presented by the celebrated Baer, and they have since been fully substantiated for the whole animal kingdom. Milne Edwards observes:—

"Each animal experiences a variety of modifications, some of which appertain to the particular species, while others are equally presented by a number, more or less large, of different animals; and the latter have a wider and wider scope, as they correspond chronologically to a more and more early part of the series of genetic phenomena. Moreover it is easy to show that it is the general tendency in nature to produce a correspondence between these primordial resemblances of animals under development, and the different degrees of zoological affinity exhibited when the species have completed their development. The modifications which are manifested successively in the constitution of the young, or germ, as it enlarges, determine successively its

existence as a member of a particular order, class, and family. I am far from believing in the identity of germs. But there is a resemblance, and this resemblance is close, as we approach the period of their origin. Hence it is that the embryogenic history of animals illustrates so fully and beautifully their natural relations."

In carrying out these principles it becomes evident that there is a natural system in animal nature, based upon a single grand principle; and farther that this system cannot be represented in a simple lineal series, but must be viewed as having its affiliations or lines of affinities, branching and reticulating in every direction and still subordinated to one plan. "There are a multitude of series which may be conceived of as branching from one another at different heights, or rather which are reunited at base, and separate and subdivide into secondary, ternary, quarternary groups, according as they diverge and take their distinctive characters, more or less near the origin of their embryonic existence."

Milne Edwards goes on to observe that the successive changes in the organization of each animal constitute three distinct series; the *histogenic* or the development of the tissues; the *organogenic*, or the production of the organs producing physiological phenomena; and the *zoogenic*, the modifications arising from the various combinations destined to make the being a zoological unity. These divisions are farther subdivided as there are various *kinds* of tissues, organs, and specific characters; and different results arise from their unequal development. "Thus, two series of histogenic phenomena of the same kind, in two different animals, or two series of such phenomena of different kinds in the same animal, may offer at first a certain number of corresponding terms; but at a period more or less advanced, these terms will cease to be analogous, and in general the divergence will continue to increase as they approach the final result." In this manner, by an arrest of development of different tissues or organs, at different periods, one animal becomes widely different from another, and there will be an analogy between a finished tissue of what we designate an inferior grade, and one of the steps in the development of a superior. "By the applications of these principles, we explain the concordance between the permanent forms of certain animals, and the transitory state of the embryo in other species whose metamorphic career is longer continued." In a natural group, the species, with a short period of development, start upon the same route which those have followed that have left them on the road. The animals, therefore, whose embryogenic career is of different lengths, constitute a number of separate series, more or less closely related, according as their differences in zoogenic progress begin more early and are wider in character. The progress of metamorphosis produces generally a higher and higher grade. But there are instances of a degradation from the same source, as with the Lernæas, which, in a transitory state, have a rank corresponding with the Cyclops, though afterwards so inferior in character.

In view of these facts, we perceive the foundation of the homologies and analogies, which have been observed between animals and groups of animals.* We comprehend how the secondary modifications run-

* Milne Edwards uses the term *direct affinity* for the immediate relations of species; *collateral affinity*, for the relations of parallel series.

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ning through one group, are repeated in another series. A natural group, says Milne Edwards, is a reunion of all the derivatives of the same type; a primary division includes all derived from the same *primary* type, or plan of development—and a secondary division, those from a *secondary* type. There are types of the first, second, third, fourth, &c., orders, and groups corresponding to each. Moreover each group may contain several natural series, parallel or otherwise, and more or less elevated in rank.

The importance of embryogeny as a means of distinctions, is at once shown by the embryonary forms of animals of the four grand divisions of the animal kingdom, as long since laid down by Baer. In the ovum of the vertebrate animal, the first step is the formation of the medial depression which divides the central portion of the blastoderm into two symmetrical halves, and corresponds to the vertebral column and its adjuncts. There is nothing similar in the invertebrata. Thus the very first point observed in the embryo of a vertebrate animal, is that which is the dominant characteristic in this whole division. Other peculiarities are pointed out in the memoir for the Articulata, Mollusca and Radiata, which bear out the same principle.

Milne Edwards presents reasons for separating the Batrachia from the Reptiles, as first proposed by Blainville, and thus makes five great divisions of the Vertebrata:—the Mammifera, Birds, Reptiles, Batrachia, and Fishes. The Reptiles are, from the first, aërial in their respiration, whilst the Batrachia, in their early state at least, have branchiæ like fishes. He observes farther, that the embryo of Fishes and Amphibia have no allantoid nor amnios, whilst in the true Reptiles, Birds and Mammifera, these parts are always distinct. He hence divides the Vertebrata into the *Vertébrés Allantoidiens* and the *Vertébrés Anallantoidiens.*

The remainder of this memoir is occupied with remarks upon the Vertebrata, with reference to their classification, which although of high importance, we have to pass by at this time, giving only in a tabular form the classification which he proposes.

A. VERTÉBRÉS ALLANTOIDIENS.

I. MAMMIFÈRES.

Monodelphiens ou Mammifères Placentaires.

Mammifères à placenta discoide.

Bimanes, Quadrumanes, Insectivores, Cheiroptères, Rongeurs.

Mammifères à placenta zonaire.

Carnivores, Amphibiens, Daman.

Mammifères à placenta diffus.

Pachydermes, Solipèdes, Ruminans, Siréniens, Cétacés, Edentés.

Didelphiens.

Marsupiaux.

Insectivores, Herbivores.

Monothrèmes.

II. OISEAUX.

III. REPTILES.

Saurieus.

Ophidiens.

Cheloniens.

B. VERTÉBRÉS ANALLANTOIDIENS.

I. BATRACIENS.

Anoures, Urodèles, Cècilies, Perennibranches, Lepidosiren.

II. FISHES.

Chondropterygiens, Poissons osseux, Cyclostomes, Amphioxus.

2. *Notices of the Fossil Bones of the Ancient Birds of New Zealand*, (in letters dated Jan. 19 and 26, 1848, from Dr. G. A. MANTELL to the Senior Editor.)—The collection of eight hundred fossil bones—all, the bones of birds (with a single exception, the femur of a quadruped, probably a dog)—is the most interesting and extensive that has been sent from New Zealand to Europe, and probably from any part of the world. Dr. Mantell submitted the bones to the examination of Prof. Owen, who had made the subject his own by his former beautiful memoirs on the Dinornis apteryx. Mr. Owen is expected to draw up a report on the bones, for the Zoological Society. He had already described the crania of the Dinornis, which were objects of great importance, but no traces of the mandibles had been previously discovered. The collections include three distinct types. The beak of the Dinornis is like a cooper's adze, and seems designed to tear up roots of plants; the base of the skull is prolonged below the foramen magnum in a very extraordinary manner, for the attachment of powerful muscles, by which the mandibles were acted upon.

*Palapteryx* (Paleo-apteryx) is a new genus, more allied to the Apteryx than is the Dinornis. The Notornis (the term signifying southern bird) is a new genus of Rallidæ, and related to a living genus of New Zealand. There are also mandibles of a species of Nestor, (a nocturnal parrot,) a genus still existing in New Zealand.

The state of preservation of the bones is remarkable; they are in this respect, wholly unlike those formerly sent. They are light and porous, and of a delicate fawn color, resembling the bones from the caverns of Germany. They were found imbedded in loose sand, the detritus of earthy augitic rocks, much resembling the loose alluvial deposits brought down by streams and rivulets in volcanic countries, as in Auvergne and the Phlegræan fields. There are but a few bones of the most gigantic species; the collection, fortunately, is richest in those bones that were most rare in the British and Hunterian museums.

Dr. Mantell adds, "I have had Mr. Dinkel* to make a restored outline of the Dinornis, or rather of its skeleton, which I have been able to make complete from the collection of my son.† The originals of the colossal species must have been glorious bipeds, some ten or twelve feet high, with a beak, as already remarked, like a cooper's adze. The birds were of all dimensions, from those of a water-hen to the colossal moa."

"The collection is offered for sale to the British Museum. To form it must have been a work of great labor, exposure, and even danger; the bones were found in places distant from any English settlement, and they had to be brought on men's shoulders through untracked forests, lakes, moors," &c.

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* The celebrated artist, formerly employed by Prof. Agassiz.

† Mr. Walter Mantell, from whom the collection was obtained.

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3. *Fossil Shells from Tertiary Deposits on the Columbia River, near Astoria;* by T. A. CONRAD.—The following interesting miocene species were collected by J. K. Townsend, and are described at his request.

*Nucula divaricata*, (figs. 1*a*, 1*b*.)—Subovate, convex, with divaricating striæ; extremities rounded; ligament margin very oblique, slightly curved; basal margin curved; beaks near the anterior extremity.

Fig. 1*a*.

Fig. 1*b*.

Fig. 2.

Fig. 3.

*N. cuneiformis*, (fig. 2.)—Ovate, ventricose in the middle, with strong lines of growth; anterior side short, margin rounded; posterior side cuneiform; subtruncated at the extremity; basal magin rounded.

*N. abrupta*, (fig. 3.)—Somewhat elliptical, convex; truncated anteriorly; ligament margin rectilinear, oblique; posterior margin obliquely truncated, contracted.

*Mactra albaria*, (fig. 4.)—Triangular, ventricose; beaks medial; umbonial slope angulated; anterior and posterior margins nearly equally oblique; posterior extremity truncated, direct; basal margin regularly curved.

*Tellina oregonensis*, (fig. 5.)—Elliptical, thin, much compressed; valves flattened, and having regular concentric fine lines; anterior submargin somewhat angulated, the margin nearly direct, truncated; beaks rather nearest to the anterior extremity; posterior end acutely rounded.

In the cast, an oblique shallow furrow meets the apex on the posterior side.

*T. obruta*, (fig. 6.)—Ovate, compressed, thin; very inequilateral; ligament margin elevated; basal margin rounded; anterior hinge margin straight and very oblique, extremity truncated.

Fig. 4.

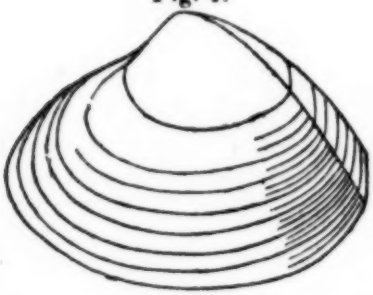


Fig. 5.

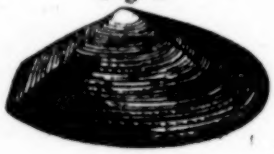


Fig. 6.

*Loripes parilis*, (fig. 7.)—Lentiform, inequilateral, not ventricose; length and height equal, summit slightly prominent; margins very regularly rounded.

*Cytherea oregonensis*, (fig. 8.)—Suborbicular, ventricose, inequilateral; summits prominent; surface with fine lines of growth; anterior extremity acutely rounded; basal margin rounded; posterior margin obtusely rounded.—This species is remarkably similar in form to *C. ovata*, Rogers, a fossil of the Virginia miocene; but it wants the impressed concentric lines of that species.

*C. vespertina*, (fig. 9.)—Acutely ovate, ventricose; very inequilateral; summits prominent; surface with concentric lines, which are not very smooth and regular; posterior side somewhat cuneiform; anterior extremity acutely rounded; basal margin rounded.

A number of specimens were together in a small fragment of rock, all of which were much smaller than the one selected to figure.

Fig. 7. Fig. 8. Fig. 9. Fig. 10. Fig. 11.

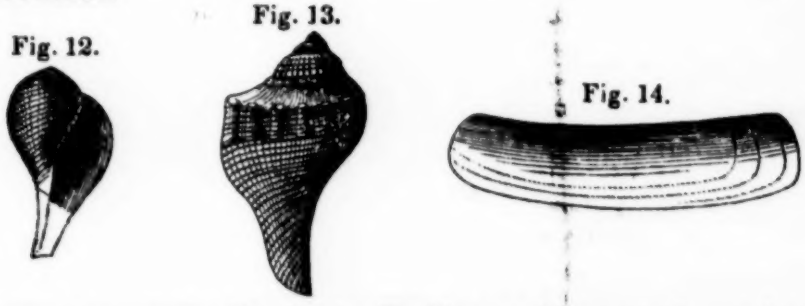
*Nucula penita*, (fig. 10.)—Ovate acute, ventricose; anterior side very short, obtuse; ligament margin concave; posterior side rostrated, acute; basal margin rounded.

Somewhat similar in outline to the Virginia miocene *N. acuta*, but has a much shorter anterior side. It is a cast, and the character of the exterior is unknown.

*Bullina petrosa*, (fig. 11.)—Narrow-cylindrical; margin of labrum straight, extremity elevated above the apex; spire slightly raised above the shoulder, which is oblique and angulated.

*Pyrula modesta*, (fig. 12.—Pyriform, thin, with approximate prominent alternated revolving lines reticulated with minute longitudinal lines; spire very short, conical; upper portion of body whorl regularly rounded.

Fig. 12. Fig. 13. Fig. 14.



*Fusus oregonensis*, (fig. 13.)—Fusiform, with unequal prominent revolving lines, a few of which are considerably larger than the others on the upper portion of the body whorl; they are also coarser towards the base, and alternated in size; shoulder with a series of tubercles; one of the larger striæ on the body whorl somewhat tuberculated; a prominent line margins the suture; spire conical, the volutions reticulated and tuberculated.

*Solen curtus*, (fig. 14.)—Slightly curved, short, convex, equally wide at the extremities; anterior margin very obliquely truncated, reflected, rounded towards the base; posterior extremity truncated, slightly oblique.

4. *Fossils of the Exploring Expedition under the command of Charles Wilkes, U.S.N.: a fossil fish from Australia, and a Belemnite from Tierra del Fuego;** described by James D. Dana, Geol. of the Exped.

UROSTHENES, (nov. gen.)—Allied to Palæoniscus.—Body elongated, prolonged into upper lobe of tail nearly to apex. Anal fin trian-

* Continued from vol. iv, of this Journal, p. 151. Figures will be given in connection with the author's Geological Report.

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gular, attached to the body as far as the base of the caudal. Dorsal fin directly over the anterior part of caudal. Ventral fin distant from the anal. Rays of the fins very fine and numerous; articulations oblong, the surface of each excavate.

*Urosthenes australis.*—Body narrow oblong. Scales smooth and without markings, subquadrate, over the posterior part of the body transverse. Caudal fin slightly furcate. Anal fin larger than dorsal; two to four free spines or accessory rays just in advance of each of the fins; articulations of rays oblong rectangular, those of dorsal fin, near its base and outer margin, three or four times as long as broad, and surface fluted-excavated.—From the B coal-pit, Newcastle, on the Hunter, where it was obtained by Mr. James Steel, the Superintendent of the works, by whom the specimen was kindly submitted to the writer for description. The specimen is in the Museum of the Newcastle Mechanics' Institute. The anterior part, to beyond the pectoral fins, is wanting. Length of part preserved 12 inches: width 2½ inches; near base of caudal fin 1 inch.

HELICERUS, (nov. gen.)—Allied to Belemnites. Calcareous ossicle thick, subcylindrical, containing internally a slender tubular cavity, (a continuation probably of an alveolus above,) which terminates in a small fusiform chamber helicoidly divided. This chamber has the shape of two cones put base to base; the tube leading to it, appears to have contained a rolled membrane to correspond with the turns of the spiral dissepiment in the fusiform chamber.

*Helicerus fuegiensis.*—Ossicle cylindrical, ½ an inch in diameter; diameter of tube within, nearly ⅙ that of the fossil; and that of the chamber more than ½ the same. Texture of the ossicle radiating fibrous, like ordinary Belemnites. Found by the writer in a slate rock on the shores of Nassau Bay, near Cape Horn.

Note.—In the valuable article by F. M'Coy on the fossils of Australia, which was published some months after the writer's article on this subject, but before that article had reached Mr. M'Coy, there are some species redescribed. We observe that

Cardinia? exilis, *M'Coy*, is *Cardinia recta*, D.

Pleurotomaria Morrisiana, *M'Coy*, is *Pleurotomaria trifilata*, D.

Pachydomus ovalis and P. pusillus, *M'Coy*, are species of *Astartila*, D., a genus nearer Astarte, than Pachydomus.

Pachydomus sacculus, *M'Coy*, is a *Eurydesma;* E. cordata? of *Morris*. (See Strzelecki's N. S. Wales, pl. 12, fig. 1.)

The genus *Notomya*, M'Coy, corresponds to *Pyramus*, D., and from the examination of our species, we can not believe that they are related to the Myidæ.

The genus *Mæonia* of the author, (changed from *Myonia*,) along with *Pyramus*, and probably *Cleobis*, make a natural group among the Astartidæ, having the smaller anterior muscular impression facing in the same plane with the larger anterior, and thus differing strikingly from *Astarte*, *Pachydomus*, *Astartila*, *Cardinia*. Moreover the large anterior is prolonged upward, and is pointed, towards the smaller anterior muscular impression. *Mæonia* has a second small anterior muscular impression, situated high up on the beak; if this is not sufficient for a generic distinction, all the species may be thrown together in the

genus *Mæonia*, as the gradations are such that it is difficult to draw lines of distinction. The *Pachydomus gigas* of M'Coy, falls into the same group, being between *Cleobis* and *Mæonia* as these genera were before laid down. The group *Cleobis* if sustained, would include species not having the sides at all excavate; but this hardly seems to be a generic character, among these species. The *Pachydomus globosus* of Morris and M'Coy, appears to be a different species from the P. globosus of *Sowerby*, whose figure in Mitchell's Australia, (Pl. 1, p. 14, vol. i,) represents a species with very *thick* valves, and from Harper's Hill, instead of Illawarra. Morris's species is believed to be *Cleobis grandis* of the writer.

The species referred in our former article to *Modiolopsis*, (Hall,) appear to have two muscular impressions, and for the most part more properly belong with the Cypricardiæ.

5. *A new Organ of Sound in Lepidoptera;* by S. S. Haldeman.—The *Lithosia miniata*, Kirby, (Fauna Bor.-Am., p. 305,) or an allied species, produces an audible stridulation by vibrating the pleura beneath the wings, this part being marked in recent specimens by parallel lines, apparently indicating the position of the muscles. It is possible that the European *Acherontia atropos* may produce its peculiar sound in a similar manner.

A writer in the Albany Journal of Science and Agriculture, asserts, that he has seen *Atropos pulsatorius*, making the noise called 'death watch,' and he alludes to an opinion of Dr. Fitch upon the same subject. This must be an error attributable to the fact, that the writer was predisposed to connect the sound with this minute and tender insect, rather than with the more solid and larger *Anobium*, to which the sound in question, as well as the name '*death-watch*,' appertains.

6. *Remark on the Insects of Mexico;* by S. S. Haldeman, (in a letter to one of the editors.)—I have recently received a small collection of insects from Tshiwawa (Chihuahua) and Santa Fé; they are not in good condition, but a cursory examination seems to give the following species, well known in this part of the United States. *Spectrum femoratum*, *Acrydium ornatum*, *Syrtis erosa*, *Carabus serratus*, *Rhagium lineatum*, *Tabanus atratus*, *Lema trilineata* and *Dromius subsulcatus;* also *Aphodius strigatus*, which occurs as far north as Lake Superior, has been sent to me from Jalapa.

## IV. Astronomy.

1. *The Relations of Neptune to Uranus.*—Messrs. Editors,—In my Historical Notice of the Planet Neptune, published in the last number of the Journal, I stated that hitherto Professor Peirce had not succeeded in explaining the whole perturbation of Uranus by the action of Neptune, and it was intimated that we might find it necessary to call to our assistance another planet hitherto unseen. I have just received from Professor Peirce the results of his recent computations, from which it will be seen that his labors have been crowned with entire success. The annexed table will shew that, assuming the mass of Neptue to be $\frac{1}{19320}$, which was deduced by Prof. Peirce from Mr. Bond's observations, the motions of Uranus are even better explained than they were by the hypothetical planet of Le Verrier. Le Verrier's orbit may be said to have represented all the observations within the limits of the



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probable errors, except the single observation of 1690, made by Flamstead. This observation was in error 20″, according to Le Verrier's computations, and 50″ according to those of Mr. Adams; while both astronomers agreed that Flamstead had made a very poor observation. Prof. Peirce's orbit represents this observation within a single second. Does not this result exhibit in a beautiful light the harmony of truth? When Le Verrier was allowed a carte blanche to create a planet to suit his convenience, when he was at liberty to assign it any mass, and make it move in any orbit he pleased, he could not explain the observation of 1690; but the planet discovered at Berlin, having a mass such as is deduced from Mr. Bond's observations, and moving in the orbit also deduced from observation, explains every thing perfectly. If then this mass is confirmed by subsequent observations, and there is no mistake in Professor Peirce's figures, (and we know no reason to distrust them,) the problem of Uranus seems exhausted. The planet discovered by Dr. Galle perfectly explains the observed inequalities of Uranus, and these observations afford no reason to suspect the existence of any other planet hitherto unseen. Annexed is the abstract of Prof. Peirce's results. I remain, yours sincerely, E. Loomis.

New York University, April 11, 1848.

**Residual differences between the theoretical and observed longitudes of Uranus, after allowing for the action of Neptune, upon the hypothesis that its mass is that deduced by Mr. Peirce from Mr. Bond's observations of Lassell's satellite, or that from the combination of Bond's and Lassell's observations, or thirdly, that its mass is that deduced by Struve from his own observations of the satellite; and also the residual differences upon the former theories of LeVerrier and Adams, transcribed from those theories; and also the residual differences which Le Verrier's best orbit of Uranus to satisfy modern observations, would have left if there had been no external planet, and which was the true basis of the theory, the base line for the measurement of the elements of Neptune previous to its discovery.**

| Date. | The mass of Neptune assumed by Mr. Peirce to be $=\frac{1}{19346}$ which was determined from Bond's observations of Lassell's satellite. | $=\frac{1}{18780}$ which was deduced by him from the combination of Bond's and Lassell's observations. | $=\frac{1}{14494}$ which was deduced by Struve from his own observations of the satellite. | Le Verrier's most probable theoretical planet, of which the mass $=\frac{1}{9333}$ | Adams's second hypothetical planet, of which the mass $=\frac{1}{6666}$ | Le Verrier's best orbit of Uranus with hypothesis of no external planet. |
|---|---|---|---|---|---|---|
| | ″ | ″ | ″ | ″ | ″ | ″ |
| 1845 | −0·9 | − 1·2 | − 2·8 | − 0·3 | | + 6·5 |
| 1840 | −1·1 | − 1·3 | − 1·3 | + 2·2 | + 1·3 | + 0·7 |
| 1835 | +2·0 | + 2·4 | + 3·9 | − 0·8 | − 1·2 | — 4·5 |
| 1829 | +0·8 | + 1·3 | + 2·5 | − 2·2 | + 2·0 | — 7·3 |
| 1824 | −2·0 | − 1·9 | − 1·6 | − 5·6 | + 1·7 | — 7·6 |
| 1819 | +1·0 | + 0·7 | + 0·9 | + 0·4 | − 2·2 | + 3·8 |
| 1813 | −0·3 | + 1·1 | − 2·3 | − 0·9 | − 1·0 | + 4·5 |
| 1808 | −0·4 | − 0·6 | − 1·3 | + 0·8 | 0·0 | + 3·8 |
| 1803 | +0·8 | + 1·2 | + 3·2 | + 0·8 | + 1·6 | − 3·4 |
| 1797 | +0·3 | + 0·8 | + 3·3 | − 1·0 | − 0·5 | — 6·7 |
| 1792 | +0·3 | + 0·5 | + 1·6 | + 0·3 | − 1·1 | — 7·8 |
| 1787 | −0·6 | − 1·2 | − 4·7 | − 1·2 | − 0·2 | + 2·0 |
| 1782 | −3·0 | − 5·6 | − 18·3 | + 2·3 | 0·0 | + 20·5 |
| 1769 | −6·0 | −16·0 | − 67·0 | + 3·7 | + 1·8 | +123·3 |
| 1756 | +4·0 | −12·7 | −102·4 | − 4·0 | − 4·0 | +230·9 |
| 1715 | +8·7 | +10·0 | − 99·6 | + 5·5 | − 6·6 | +279·6 |
| 1690 | +0·8 | +13·0 | −124·7 | −19·9 | +50·0 | +289·0 |

Cambridge Observatory, March 23, 1848.

NOTE.—It is proper to observe, that the elements of Neptune employed by Prof. Peirce are essentially different from those which have been made the basis of previous investigations. Hence arises the discrepancy between his results and those previously announced, in the New Haven Daily Herald, by Mr. E. F. BURR of this place. With the elements of earlier date, it was found impossible to reduce the unexplained irregularities of Uranus two-thirds, without attributing to Neptune a mass totally irreconcilable with observation.

The importance of the problem that concerns the motions of Uranus, and the liability to error in inquiries so long and intricate as those that are requisite for its solution, make it desirable to compare the results of independent processes. Such a comparison we shall probably soon have the means of instituting. We understand that Mr. Burr has undertaken, and nearly completed, an investigation with the new data of Mr. Walker, which embraces an extended comparison of the theoretical and observed places of Uranus, and with that degree of approximation in the results pertaining to the work, which would have been required of astronomers, had the new planet proved insufficient for the complete reduction of the residual perturbations.

2. *A Meteor visible for a considerable time*, (extract of a letter from EDWARD HUNTINGTON, Esq., dated Rome, N. Y., 20th January, 1848.)—At about five o'clock this evening I observed a large and brilliant meteor, which was visible in the western part of the heavens for a second or two, at an elevation of perhaps 35° above the horizon when first noticed, and a few degrees, say five or ten, north of west. It moved northward until it reached a point about 25° north of west, and 30° above the horizon, when it seemed to run out, leaving behind it a train, the greater part of which vanished almost instantly, but a portion of it remained visible about *twelve or thirteen minutes*. At first it consisted of two short lines of light, very near each other, bright and well defined; they soon, however, contracted somewhat in length and dilated in width irregularly, the brilliancy of the light at the same time being diminished until they united in an irregular oblong mass resembling a white cloud which floated northward and eastward very slowly until it faded from sight.

The light was sufficiently strong to be visible through some cirrous clouds which passed across it seven or eight minutes after the appearance of the meteor, and when first seen was at or near the point where the meteor became visible.

## V. MISCELLANEOUS INTELLIGENCE.

1. *Orthography in Chemistry.*—The fact that the received nomenclature in chemistry is of French origin, accounts for the departures from correct principles of orthography, to be found in most chemical writings in the English language. The word *oxyd* is commonly written *oxide*, although it is plain that the Greek derivation requires the *y*. *Oxyde* is sometimes seen in French, and occasionally appears in English chemical works. This is nearer right. But this word, together with *chloride*, *bromide*, and the like, have no more right to an *e* than the word *acid*. The French are consistent in using the terminal letter

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in all these words, *acide*, *chloride*, *bromide*, &c., and are sustained by the analogy of their language. But by adopting the French orthography, we desert the strict principles of our own language for no sufficient reason. *Oxydum*, *chloridum*, *bromidum*, (Latin is well known to be the proper language of the chemical nomenclature, although many of the words are Greek in origin,) are similar Latin words with *acidum*; and *oxyd*, *chlorid*, *bromid*, *acid*, are properly the English forms of these words. *Acrid*, *flaccid*, *rabid*, *hybrid*, *splendid*, *fluid*, *stupid*, are other analogous words in English.

The reasons here presented, have influenced us in adopting the orthography used in this Journal.

2. *Gutta Percha;* by Thomas Oxley, Esq., A.B., Senior Surgeon of the Settlement of Prince of Wales' Island, Singapore, and Malacca, (Journ. Ind. Archip., Singapore, No. 1, 1847, p. 22.)—The gutta percha tree, or gutta túban as it ought more properly to be called,—the percha producing a spurious article,—belongs to the natural family Sapoteæ, but differs so much from all described genera, having alliance with both Achras and Bassia, but differing in some essentials from both, that I am disposed to think it is entitled to rank as a new genus. I shall therefore endeavor to give its general character, leaving the honor of naming it to some more competent botanist, especially as I have not quite satisfied myself regarding the stamens from want of specimens for observations.

The tree is of large size, from sixty to seventy feet in height, and from two to three feet in diameter. Its general appearance resembles the genus Durio, or well known Doorian, so much so as to strike the most superficial observer. The under surface of the leaf, however, is of a more reddish and decided brown than in the Durio, and the shape is somewhat different. The flowers are axillary, from one to three in the axils, supported on short curved pedicles, and numerous along the extremities of the branches. Calyx, inferior, persistent, coriaceous, of a brown color, divided into six sepals which are arranged in double series. Corolla, monopetalous hypogenous, divided like the calyx into six acuminate segments. Stamens, inserted in the throat of the corolla, in a single series, variable in number, but, to the best of my observation, the normal number is twelve, most generally all fertile, anthers supported on slender bent filaments, opening by two lateral pores. Ovary, superior, terminated by a long simple style, six celled, each cell containing one seed. Leaves about four inches in length, perfect, entire, of a coriaceous consistence, alternate, obovate lanceolate, upper surface of a pale green, under surface covered with close, short, reddish brown hairs. Midrib projects a little, forming a small process or beak.

Every exertion of myself and several others have failed in procuring a specimen of the fruit of the gutta, I regret being compelled to omit the description of it in the present instance, but hope to rectify this omission in some future number of the Journal. It is quite extraordinary how difficult it is to obtain specimens of either the flower or fruit of this tree, and this is probably the reason of its not having been earlier recognized and described by some of the many botanists who have visited these parts.

Only a short time ago the túban tree was tolerably abundant on the Island of Singapore, but already all the large timber has been felled, and few, if any, other than small plants are now to be found. The range of its growth, however, appears to be considerable; it being found up all the Malayan Peninsula as far as Penang where I have ascertained it to be abundant; although as yet the inhabitants do not seem to be aware of the fact: several of the mercantile houses there having sent down orders to Singapore for supplies of the article, when they have the means of supply close at hand. The tree is also found in Borneo, and I have little doubt it is to be found in most of the Islands adjacent.

The localities it particularly likes are the alluvial tracts along the foot of hills, where it flourishes luxuriantly, forming, in many spots, the principal portion of the jungle. But notwithstanding the indigenous character of the tree, its apparent abundance, and wide spread diffusion, the gutta will soon become a very scarce article, if some more provident means be not adopted in its collection than that at present in use by the Malays and Chinese.

The mode in which the natives obtain the gutta is by cutting down the trees of full growth and ringing the bark at distances of about twelve to eighteen inches apart, and placing a cocoanut shell, spathe of a palm, or such like receptacle, under the fallen trunk to receive the milky sap that immediately exudes upon every fresh incision. This sap is collected in bamboos, taken to their houses, and boiled in order to drive off the watery particles and inspissate it to the consistence it finally assumes. Although the process of boiling appears necessary when the gutta is collected in large quantity; if a tree be freshly wounded, a small quantity allowed to exude, and it be collected and moulded in the hand, it will consolidate perfectly in a few minutes and have all the appearance of the prepared article.

When it is quite pure the color is of a greyish white, but as brought to market it is more ordinarily found of a reddish hue, arising from chips of bark that fall into the sap in the act of making the incisions, and which yield their color to it. Besides these accidental chips, there is a great deal of intentional adulteration by sawdust and other materials. Some specimens I have lately seen brought to market, could not have contained much less than one-fourth of impurities; and even in the purest specimens I could obtain for surgical purposes, one pound of the substance yielded, on being cleaned, one ounce of impurities. Fortunately it is neither difficult to detect or clean the gutta of foreign matter; it being only necessary to boil it in water, until well softened, roll out the substance into thin sheets, and then pick out all impurities, which is easily done as the gutta does not adhere to any thing, and all foreign matter is merely entangled in its fibres, not incorporated in its substance. The quantity of solid gutta obtained from each tree varies from five to twenty catties, so that, taking the average at ten catties which is a tolerably liberal one, it will require the destruction of ten trees to produce one picul. Now the quantity exported from Singapore to Great Britain and the continent from 1st January, 1845, to the present date, amounts to 6,918 piculs, to obtain which, sixty-nine thousand one hundred and eighty trees must have been sacrificed. How

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much better would it therefore be to adopt the method of tapping the tree, practiced by the Burmese in obtaining the caoutchouc from the Ficus elastica, (viz., to make oblique incisions in the bark, placing bamboos to receive the sap which runs out freely,) than to kill the goose in the manner they are at present doing. True they would not at first get so much from a single tree, but the ultimate gain would be incalculable, particularly as the tree appears to be one of slow growth, by no means so rapid as the Ficus elastica. I should not be surprised, if the demand increases, and the present method of extermination be persisted in, to find a sudden cessation of the supply.

*Properties of the Gutta.*—This substance when fresh and pure is, as already mentioned, of a dirty white color and a greasy feel, with a peculiar leathery smell. It is not affected by boiling alcohol, but dissolves readily in boiling spirits of turpentine, also in naphtha and coal tar. A good cement for luting bottles and other purposes is formed by boiling together equal parts of gutta, coal tar and resin. I am indebted for this hint to Mr. Little, Surgeon, and the above were his proportions. I have, however, found it necessary to put two parts of the gutta, that is one-half instead of one-third, to enable the cement to stand the heat of this climate. When required for use it can always be made plastic by putting the pot containing it over the fire for a few minutes. The gutta itself is highly inflammable, a strip cut off takes light, and burns with a bright flame, emitting sparks, and dropping a black residuum in the manner of sealing wax, which in its combustion it very much resembles. But the great peculiarity of this substance, and that which makes it so eminently useful for many purposes, is the effect of boiling water upon it. When immersed for a few minutes in water above 150° Fah., it becomes soft and plastic, so as to be capable of being moulded to any required shape or form, which it retains upon cooling. If a strip of it be cut off and plunged into boiling water, it contracts in size both in length and breadth. This is a very anomalous and remarkable phenomenon, apparently opposed to all the laws of heat.

It is this plasticity when plunged into boiling water that has allowed of its being applied to so many useful purposes, and which first induced some Malays to fabricate it into whips, which were brought into town and led to its farther notice. The natives have subsequently extended their manufactures to buckets, basins and jugs, shoes, traces, vessels for cooling wine, and several other domestic uses; but the number of patents lately taken out for the manufacture of the article in England proves how much attention it has already attracted, and how extensively useful it is likely to become. Of all the purposes, however, to which it may be adapted none is so valuable as its applicability to the practice of surgery. Here it becomes one of the most useful auxiliaries to that branch of the healing art, which of all is the least conjectural. Its easy plasticity and power of retaining any shape given to it when cool, at once pointed it out as suitable for the manufacture of Bougies, and accordingly my predecessor, Dr. W. Montgomerie, availed himself of this, made several of the above instruments, and recommended the use of it to the Bengal Medical Board. But, like many other good hints, for want of sufficient enquiry, I fear it was disregarded. The

practice, however, has been continued by me, and I find many advantages in the use of this substance. It also answers very well for the tubes of syringes which are always getting out of order in this country when made of caoutchouc. But my late experiments have given it a much higher value, and proved it the best and easiest application ever yet discovered in the management of fractures, combining ease and comfort to the patient, and very much lessening the trouble of the surgeon. When I think of the farago of bandages and splints got rid of, the lightness and simplicity of the application, the gutta would be no trifling boon to mankind were it to be used solely for this and no other purpose. The injuries coming under my observation, wherein I have tested its utility, have, as yet, only been two compound fractures of the leg, and one of the jaw. But so admirably has it not only answered, but exceeded, my expectations, that I should think myself culpable in not giving the facts early publicity. Its utility in fracture of the lower jaw must at once strike any surgeon. So well does it mould itself to every sinuosity, that it is more like giving the patient a new bone than a mere support. A man lately brought into the hospital, who had his lower jaw broken by the kick of a horse, and which was so severe as to cause hemorrhage from the ears, smashing the bone into several fragments, was able to eat and speak in three days after the accident, and felt so well with his gutta splint that he insisted on leaving the hospital within ten days. My mode of applying this substance to the fractures of the leg is as follows.

The gutta having been previously rolled out into sheets of convenient size, and about one-fourth of an inch in thickness, is thus kept ready for use. When required, a piece of the necessary length and breadth is plunged into a tub of boiling water. The limb of the patient is then gently raised by assistants, making extension in the usual manner. The surgeon, having ascertained that the broken bone is in its place, takes the sheet of gutta out of the hot water, and allows it to cool for a couple of minutes. It is still soft and pliable as wash leather. Place it whilst in this state under the limb, and gently lower the latter down on it. The gutta is then to be brought round and moulded carefully to the whole of the back and sides of the leg, bringing the edges close together, but not uniting them. If there be any superfluous substance, it can be cut off with a scissor, leaving an open slit down the front of the leg. You have now the leg in a comfortable, soft, and smooth case, which, in ten minutes, will be stiff enough to retain any shape the surgeon may have given it, and which will also retain the bone in place. Place the leg so done up on a double inclined plane, and secure it thereto by passing three of the common loop bandages around the whole,—that is one at the top, one in the middle, and one at the lower end. Let the foot be supported by a foot board, and a case of gutta put over the dorsum of the foot, to bear off the pressure of the small bandage generally used to secure it to the board. Having done this, the surgeon need not cause his patient another twinge of pain until he thinks he can use the leg, or he deems the bone sufficiently united to bear the weight of his patient. If it be a compound fracture it will only be necessary to untie the loop bandages, separate the edges of the gutta splint to the required distance, wash and cleanse the limb

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without shifting any thing except the dressings, and having done so, shut it up again. The most perfect cleanliness can be maintained, as the gutta is not affected by any amount of ablution; neither is it soiled or rendered offensive by any discharge, all which washes off as easily from the gutta case as from oil cloth. I have had a patient where the tibia protruded through the integuments fully two inches, walking about in six weeks from the injury, with the leg as straight and well formed as it ever had been. It is quite obvious therefore that if it answers so well for compound, it will answer equally, if not better, for simple, fractures; and that any broken bone capable of receiving mechanical support can be supported by the gutta better than by any other contrivance. For it combines lightness and smoothness, durability and a capability of adjustment, not possessed by any other known substance. All new experiments have to run the gauntlet of opposition, and I do not suppose that these recommendations will prove an exception to the rule. But all I ask of any surgeon is to try the experiment ere he argues on its propriety, and I feel fully convinced that all other splints and bandages will be consigned to the tomb of the capulets. There are some other uses for which I have tried this substance, viz., as capsules for the transmission of the vaccine virus, which ought to keep well when thus protected, for it is most perfectly and hermetically sealed. But I have not had sufficient experience in this mode of using it to pronounce decidedly on its merits. I am at present trying the effects of it on ulcers, by enclosing the ulcerated limb in a case of gutta so as to exclude all atmospheric air, and, so far, the experiment promises success.

Since writing the foregoing observations I have had an official intimation from Penang of the vaccine virus transmitted in the gutta capsules having been received in good order, and of its having succeeded most satisfactorily. I have also opened a capsule containing a vaccine crust that had been kept here for one month, and it also seems to have lost none of its efficacy as the case inoculated has taken. This will appear the more striking when it is recollected that to preserve the vaccine virus hitherto in Singapore, even for a few days, has been almost impossible,—that this settlement, notwithstanding every exertion on the part of both private and public practitioners, has been without the benefit of this important prophylactic for an interval sometimes of two years,—and that, at all times, the obtaining and transmitting this desirable remedy has been a cause of trouble and difficulty to all the medical officers I have ever met with in the straits.

I observe in the *Mechanics Magazine* for March, 1847, a notice of several patents taken out for the working of this article by Mr. Charles Hancock, in which an elaborate process is described for cleaning the gutta, as also mention of its having a disagreeable acid smell. The gutta when pure is certainly slightly acid, that is, it will cause a very slight effervescence when put into a solution of soda, but is unaffected by liquor potassa. The smell although peculiar, is neither strong nor unpleasant, so that the article experimented upon must have been exceedingly impure, and possibly, derived a large proportion of its acidity from the admixture and fermentation of other vegetable substances. Again, it appears to me that, if the gutta be pure, the very elaborate

process described as being necessary for cleaning it, is superfluous. The gutta can be obtained here in a perfectly pure state by simply boiling it in hot water until well softened, and then rolling it out into thin sheets, when, as I have before said, all foreign matter can be easily removed. I would recommend that the manufacturers at home should offer a higher price for the article if previously strained through cloth at the time of being collected, when they will receive the gutta in a state that will save them a vast deal more in trouble and expense than the trifling addition necessary to the original prime cost.

3. *Spencer's Microscopes.*—We have a more recent letter from Prof. Bailey than those published in our last number, (page 285,) giving the results of late observations with Spencer's lenses. Prof. Bailey says: Foreign microscopists might not estimate correctly our artist from my statement in your last number, that Spencer's lenses would freely resolve the *longitudinal* and *transverse lines* on the Navicula hippocampus; but they will appreciate his merit when they learn that the transverse lines of the Navicula Spencerii, are more minute than the *diagonal* lines on any variety of the N. hippocampus which I have seen. An English writer states that not one glass in five hundred will show in a satisfactory manner the three sets of lines on the variety E. of the English N. hippocampus. Specimens agreeing perfectly with the description of this variety occur in the Hudson River, and on these I can easily see the three sets at once. Indeed the diagonals on this variety are by no means as difficult as the corresponding lines on the Navicula baltica, (from Rockaway,) which Spencer's objective has enabled me to detect. These last are nearly if not quite as difficult test objects as the transverse lines on the N. Spencerii. It is with great satisfaction that I can now state, that by Spencer's lenses I can with *ease* and *certainty* resolve the lines on the latter species, which lines as far as I know, are the most difficult of all tests for high powers.

West Point, April 8th, 1848.

## OBITUARY.

4. *The late Dr. Thomas P. Jones.*—The National Intelligencer of April 3d, contains the following notice of a gentleman who was extensively known throughout the country, and universally respected and esteemed:—

The decease of this gentleman has been made known through the public prints, but no extended notice of his life and labors has yet appeared. We hope to see one from a pen capable of doing him full justice, while, in the mean time, our own shall record some of the principal events in his life. His labors and exertions in various official duties and public trusts, extending through nearly forty years, call for a suitable acknowledgment from his survivors and many friends. He has long ranked high as a man of general science, and the world is indebted to him for two of the best treatises on Chemistry and Mechanical Philosophy which have appeared. At an early period he was appointed Professor of Chemistry and Natural Philosophy in William and Mary College, Virginia; afterwards in the Columbian College, District of Columbia; then of the Franklin Institute, Philadelphia. Here he commenced the publication of the Journal of the Institute, first at his



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own expense; and through this work, which he continued to edit for twenty-eight years, until his death, he was enabled to do much for the advancement of science and the arts in this country.

His connexion with the United States Patent Office, over which he was appointed Superintendent by President John Quincy Adams, brought him at once into acquaintance with the leading mechanics and artisans of the country, and contributed not a little to diffuse a more general and accurate scientific knowledge among them. It also brought into requisition his accurate knowledge of the history and the details of the patented inventions of other countries, to which reference would be important before pronouncing upon the novelty and validity of American inventions. He was so well informed on these subjects that, with his strength of memory, when a supposed improvement was laid before him, he could refer to the work and the very page where the same thing had been described and claimed long before. In this way he could often save the applicants all further trouble and expense. His written specifications of patents, and his monthly commentaries upon those which had been issued, as recorded in the Franklin Journal for many years, are remarkably clear and discriminating, conveying to the reader at once an accurate and comprehensive idea of each particular subject; and while they are eminently simple and practical, the deductions and applications of theoretical science are frequently brought in to illustrate or enforce his statements. These were far from being always favorable to the inventors. Were they collected together into one volume, covering as they do the whole field of mechanical science, they would form a most valuable work for practical reference, to show what had already been done by American inventors.

For the last fifteen years, though again connected with the Patent Office as Examiner of Patents, and afterwards selected as one of the commissioners to investigate into the cause of the explosion of steam-boilers, (both, government appointments,) his principal employment was that of attorney for procuring patents. In this capacity he renewed his former usefulness, and met with abundant success, his knowledge of the patent laws of other countries in which patents were sought through him, as well as of the decisions of our own courts, enabling him to act with the greatest readiness and certainty. His opinions were often sought in courts of law involving patent claims, and in appeals from the decisions of the office.

In fact, his familiarity with mechanical matters had become such, as to make him by common consent the general arbiter of mechanical disputants. His acquaintance with the most distinguished men of science, both abroad and at home, was extensive, and their high opinion of him is attested by his election as honorary member of various learned institutions with which they were connected.

In 1841, his restoration to the Patent Office was urged by testimonials from all parts of the country, emanating from sources calculated to give them great weight.

Of his private life much could be said. He passed through the world always possessing a happy, cheerful disposition, generous, humane, simple and unassuming, unreserved and communicative even when overwhelmed with business, and never uncourteous or impetuous. These

are expressions which have not often a true application, but those who knew Dr. Jones will attest to their absolute truth. Of his religious character we could also speak in the highest praise; but on this point any further remarks would be more appropriately reserved for an expressly religious journal. His sickness was short, and unattended by suffering; and during his last few days his mind, as is often the case, was at times clearer than it had been for years, and he said many things which made all around him happy. He was conscious to the last moment.

A.

5. *The late Professor Vanuxem.*—American science has rarely been deprived of a more able devotee than the late Professor Lardner Vanuxem, and his friends and the friends of science, have met with a loss in him not easily repaired. In early life his mind was drawn to the cultivation of chemistry and mineralogy, and his father, the late James Vanuxem, Esq., an eminent merchant, and most useful citizen of Philadelphia, gave his son the advantage of three years residence in Paris, at the School of Mines, where he became the associate of Brongniart, the Abbe Hauy, and other distinguished men, who were then prominent as professors in the schools of that great scientific metropolis. He there formed an intimate acquaintance with the late Professor Keating, who, in the same walks, was drinking from the same fountain of knowledge.

Distinguished in that admirable school for his zeal and acquirements, as well as for his modesty and amiable deportment, he became endeared to all who made his acquaintance. On his return to this, his native city, he came charged with all the improvements of recent chemical discoveries, and the advancement in its kindred arts; but he preferred the more abstract pursuit of his studies than the application of his knowledge to the practical arts. Almost immediately after his return home, he was invited by the late President Cooper to take a part of the duties in the college at Columbia, South Carolina, where he became a member of Judge Cooper's family, and acquired the friendship of all around him.

Having been solicited in 1826 to take charge of a gold mine near to the city of Mexico, he retired from the chair of Chemistry in South Carolina College, and remained a short time at the mines. Satisfied that no profitable result could accrue to the proprietors, he acted as he always had done, in conscientiously advising its being abandoned. On his return he purchased a farm near to Bristol, Penn., and soon after married the daughter of his neighbor, the late John Newbold, Esq. This farm remained the home of his family and himself until his death, on the 25th day of January last. But while he cultivated his farm, often with his own hands assisting in the labor of it, he never at any moment ceased to cultivate his already extensive acquirements in Geology, Mineralogy and Chemistry, nor to add to a collection of specimens of great extent and rareness. In this retirement, unobtrusive in all respects, however full of merit, he was sought, and invited to take a leading portion of one of the most magnificent investigations ever made in the geological developments of any country, or by any government.

He was solicited by Gov. Marcy, of New York, to take a share of the great labor of the geological survey of that state; and after five or

six years he returned to the duties of his farm. His portion of the great work published by the state, as reports from the State Geologists and Naturalists, is that which will remain his monument, and on which the reputation of his scientific attainments is based. The whole was a labor—noble and liberal in its conception—admirable in its execution, and all who did their duty with the same zeal and intelligence as the subject of this notice, will acquire a fame enduring as the science they have so well promoted.

In all the relations of domestic life, Professor Vanuxem set an example to all around him. Amiable, cheerful and intelligent, he was always welcomed into every circle—his early friendships were continued and faithful to the end of his life, and those who enjoyed his confidence and friendship, will not find it easy to fill the void he has left in their association.—*North American, Philadelphia.*

## VI. Bibliography.

1. *A Description of Active and Extinct Volcanoes, of Earthquakes, and of Thermal Springs; with remarks on the causes of these phenomena, the character of their respective products, and of their influence on the past and present condition of the globe.* By Charles Daubeny, M.D., F.R.S., Professor of Chemistry and of Botany in the University of Oxford, and member of many learned societies. Second edition greatly enlarged. London: Richard & John E. Taylor. 1848.

The first edition of this work appeared in 1826, in 466 pages octavo. The illustrations were fourteen wood-cuts—a frontispiece of the Mexican volcano of Jorullo—a folded map of the country contiguous to the bottom of the Mediterranean and the north end of the Red Sea, i. e., Palestine, the Desert of Arabia, &c.—and a map of a single page for the active volcanoes of Mexico.

The new edition contains 728 pages, equivalent to more than 860 pages of the first edition, and therefore almost double in quantity of matter. The illustrations are thirty-eight wood-cuts, four engraved plates and five engraved maps of the octavo size, besides a folded map of the United States. The getting up of this edition in paper, printing and engraving, is decidedly superior to that of the first edition, and it forms a large and elegant volume.

The author remarks in the preface to this edition, that he has used both condensation and suppression of less relevant matter; that the lines are closer, and a smaller type employed for less important details; but owing to the great accumulation of materials, the work has swollen greatly in size, especially as earthquakes and thermal springs have been in this edition much more fully discussed than in the former one. The arrangement remains substantially unchanged, and the work may serve both as a guide to the traveller, and an authority to the student at home. Dr. Daubeny still retains the same views of volcanic and terrestrial theory with which he began, and he justly regards them as having been fortified by the progress of science, especially in chemistry.

The author has in this edition enjoyed the aid of the great classical work of Leopold de Buch, "Description Physique des Isles Canaries, suive d'une Indication des Principaux Volcans de Globe;" Paris, 1836—

to which all writers on these subjects, since that work appeared,* are greatly indebted, since it contains an elaborate digest of the history of volcanoes, drawn extensively from the author's personal observations in Europe and Africa, and from numerous original sources, especially travels and voyages of discovery; it is moreover illustrated by a splendid folio atlas of large size.

Dr. Daubeny has also posted up his subject from journals of science, from travels, and from all available sources; so that it now stands as *the English classic on volcanoes*, and is, along with the work of Leopold de Buch, quite indispensable to all geological libraries and teachers.

It is superfluous to say that Dr. Daubeny has executed his work with accuracy and fidelity, so that it is a reliable volume on this most important part of the history of the earth. Into his style he has infused the graces of literature, and apt quotations from the ancient classics are often made in support of physical facts; and while they illustrate and support his statements, they add to it the attractions of elegant composition. Dr. Daubeny writes with the authority in part of an original observer, who has seen many of the most interesting portions of Europe and of North America; and his high character both as a philosopher and a writer, will of course produce a demand for his work as extensive as the field of geological science.

2. *Wonders of Geology, or a familiar Exposition of Geological Phenomena;* by GIDEON ALGERNON MANTELL, LL.D., F.R.S., &c. &c., *author of The Medals of Creation, Thoughts on Animalcules, &c.* In two volumes. Sixth edition. London: Henry C. Bohn. 1848.—This work was reviewed in the American Journal, vol. xxxiv, p. 387, and vol. xxxix, p. 1. Comparing the present edition with that of 1839, published for this country as well as for England, we find that the contents are in the proportion of about 1200 to 800 pages—due allowance being made for a larger and fuller page in the new edition.

The illustrations in beautiful wood-cuts, are in this edition, including the tail piece, two hundred; in the former edition they were one hundred and fifty-five.

The number of plates is diminished from ten to six. Among the omissions is the general sectional view of the structure and arrangement of the globe, an omission for which the author had, doubtless, good reasons; we cannot but regret however, that an illustration so essential to the clear conceptions of the student should have been omitted, even if some parts of the order and arrangement are not perfectly settled. The geological map of England has been drawn anew by the author, the former map having been copied from Mr. Bakewell's geology. The author's map is neatly got up and is as comprehensive and clear as any map, on so small a scale, (a little more than half of a page of the work,) can be.

The beautiful colored plates of corals, two in number, are preserved, but with additions and suppressions, and with some change in the order of the figures.

* Von Buch published the first outlines of his work in the Transactions of the Academy of Berlin, for the Canary Islands, especially Lancerote, in 1818, 19, and for Teneriffe in 1820, 21, followed in 1825 by the publication of his volume in German, of which the work cited in the text is a translation.

The omitted plates are :—1. The remains of a fossil crocodile, discovered at Swanage.—2. The general section of the earth.—3. The English strata, but these are now seen in figures upon the text in connexion with the descriptions of them.—4. The remains of the reptiles of Tilgate forest, as seen separately, but we have the most important of them grouped in the view of the Maidstone skeleton.

The volcanic district of France is exhibited as regards the craters, in a new, enlarged and beautiful state, but a number of subordinate sections of that region are omitted.

The plan of placing as many figures as possible in the text is excellent, and so is that of confining the sections and maps to the size of the page; that is, it is highly convenient in saving the trouble and injury arising from the unfolding of maps, but it sometimes produces such miniatures that we cannot avoid wishing for more room, that we may see important details more distinctly.

In his earlier works, the account of the Iguanodon and Tilgate forest, and the other quarto volume on the geology of Sussex and the southeast of England, as well as in quarto memoirs, Dr. Mantell gave occasionally large plates. In his late work on the Isle of Wight, there is a folded map of that island which is very satisfactory. If folded maps are placed on the right of the subject to which they refer, and are allowed sufficient blank paper to permit the map to be unfolded and read when the contiguous pages are shut down upon them, then they may be used with no serious inconvenience and with little injury.

On former occasions, as cited above, we gave our opinions fully in favor of Dr. Mantell's Wonders of Geology, which is the most attractive work on the science of geology in the English language. The new edition is brought up fully to the present state of the science, and bears the mark of great labor and skill in selecting, condensing and arranging the immense mass of facts upon which geology is erected. The author's reasoning also is clear, forcible and conclusive—with some allowance for the different views taken of the same facts by different minds. The Wonders of Geology as exhibited by Dr. Mantell, present a fruitful theme of instruction, and a delightful entertainment. His luminous and elegant style, his happy explanations, and his most beautiful artistical illustrations, are all in keeping, so that these volumes are the proper companions of the parlor, as well as of the lecture room, and they will prove also, as they have long proved, most instructive partners of a journey.

Dr. Mantell's four most recent works—The Wonders of Geology, The Medals of the Creation, Thoughts on Animalcules, and The Geology of the Isle of Wight—form a series which is entitled to a place both in libraries of natural science and of elegant literature. His earlier quartos on the geology of his native Sussex and the southeast of England, are elaborate works on a country eminently rich in fossils, and affording a fine field for geological induction, which has been skillfully and successfully employed by the author. His Thoughts on a Pebble are very good thoughts, which however would not be apt to occur to any but a highly enlightened and elevated mind. All these things, with numerous memoirs on particular subjects, the result of much personal labor in the field as well as in the closet, cause no small

surprise that in the midst of arduous professional labors, and in later years under the pressure of severe physical suffering, the author could find time and courage enough to persevere in his works until they are accomplished. Dr. Mantell has also great advantage in prosecuting natural history, since he draws with facility and success, and has a fine tact in developing minerals, and especially fossils, and extricating them from their entanglements with foreign matters. This we know from the numerous and highly interesting specimens with which he has favored us during a long series of years—sufficient to illustrate the beautiful subject of the secondary and tertiary formations of England.

We add brief notices of the particular subjects, most of which impart a peculiar interest to the present edition. The author still adheres to the nebular theory, although so many nebulæ have been resolved into clusters of stars, and others still will doubtless be resolved, without limit, as our telescopes increase in power. Encke's comet, and the tails of comets, and the zodiacal light, and atmospheres, are regarded as proof sufficient that there is matter in a nebular state. Encke's comet revolves in an orbit, and still the stars can be seen through its almost transparent form, pp. 44, 472. The Gulf Stream and other "rivers in the ocean" are distinctly traced, p. 71. The siliceous deposits and incrustations of Iceland and New Zealand are described—the latter, especially, being very remarkable, pp. 98, 99. Interesting remarks on the laws of the extinction of animals, pp. 125—132, both by natural causes and by human agency. The mammoths of Russia and their probable adaptation to a peculiar climate, p. 153, &c. Ingenious suggestions respecting the bones in caverns and fissures, and the probable manner in which they were conveyed into these places, pp. 181—183. The ratio of shells in the different members of the tertiary, and the different animals that followed next in the order of creation, p. 215, note. The existence or non-existence of animals at different depths in the sea, and the causes, p. 218, note. Some acute discriminations on the fossil fox of Œningen, and upon the analysis of genera and species, with an assertion of the author's claims, p. 264, note. Origin of flint, p. 300. Osteological questions between Prof. Owen and Dr. Mantell, notes, pp. 436, 437, 440. Observations and discoveries of Mr. Reginald N. Mantell in the Oxford clay, near Trowbridge; of the fine fossils there obtained we have received an interesting collection from Dr. Mantell, p. 502, note. Carboniferous oolite of Eastern Virginia, by Prof. Rogers, p. 520. African fossil reptiles, p. 552, 553. Remarkable coal deposit, p. 666. Silicification, p. 710, 711. Formation of coal, p. 729—731. Reptiles in the carboniferous formation of Western Pennsylvania first observed by Dr. King, and the information communicated by him to Prof. Silliman, who made the arrangement for Mr. Lyell to see the impression in situ, p. 742. Contorted strata, p. 846. Geological position of metals and auriferous alluvia of Russia, p. 869. Instructive retrospect, p. 881, and general inferences, p. 890. Supposed variable heat of the sun, Dr. J. Herschell, p. 908.

3. *De Candolle's Prodromus.*—The long-expected eleventh volume of this work was published at the close of November last, or rather in December, and is now in the hands of botanists throughout Europe and

America. It comprises, 1st, the OROBANCHACEÆ, by Mr. Reuter of Geneva; the true genera of which are *Epiphegus* of the United States; *Philipæa*, containing thirty-eight species of the Old World, and two of North America west of the Mississippi; *Conopholis* (for the Orobanche Americana, *L.*); *Orobanche*, of over ninety species belonging to the temperate regions of the Old World; *Boschniakia* of two high northwest American and Siberian species; *Clandestina* of one south European species; *Lathræa* of two Old World species; and *Anoplanthus*, Endl. (Anoplon, *Wallr.*), which is made to embrace not only the three genuine species of North America, but also a separate section corresponding with Anblatum, *Endl.*, of two species of central Asia. The earlier recent name of this last genus, is *Gymnacaulis*, Nutt.; the next is *Anoplon*, by Wallroth. This was changed by Endlicher to *Anoplanthus*, because there is an Anoplon in zoology—an insufficient reason—with which however, we need not trouble ourselves, since all three must give way to the early and excellent name of *Aphyllon*, founded by Mitchell, and published in 1748, on the typical species afterwards called Orobanche uniflora by Linnæus. This name, the revival of which is demanded not only by statute law, but also for the avoidance of the intricately conflicting names recently imposed, was adopted in the MSS. for this family prepared for the *Flora of North America*, and also in the writer's *Manual of the Botany of the Northern United States*. Besides *Aph. uniflorum*, we have in the west and north, *A. comosum*, and *A. fasciculatum*. To the Genera affinia vel dubia, Reuter appends *Obolaria*, which is correctly described, except that the insertion of the ovules over the whole inner surface of the ovary is overlooked; the present writer's illustration of this genus not having reached Geneva until after this family was printed off.

The great family of this volume, occupying almost four hundred pages, is the order *Acanthaceæ*, which is contributed by Nees von Esenbeck. This chiefly tropical or subtropical family, founded less than forty years ago upon a small number of genera and species, now ranks among the largest of the monopetalous series, and is arranged by Nees under two suborders, eleven tribes, and one hundred and forty-six genera, (including those of the appendix.) We have few Acanthaceæ in the United States, so that an analysis of the family would not interest our readers. We are pleased to find that the writer's reference of the Ruellia justiciæflora, *Hook.*, (the Eberlea of Riddell,) to the genus *Hygrophila*, R. Br., (vide *Pl. Lindheim*, p. 22, note,) is confirmed by Nees von Esenbeck. It appears that the species is also Mexican, and had been already described by Schlechtendal. Our Ruelliæ belong to *Dipteracanthus* and *Calophanes*. Our *Dianthera Americana*, L., with its allies, is included in the large genus *Rhytiglossa*, established by Nees (in *Lindl. Introd. Nat. Syst.*, ed. 2) a few years ago, on some Cape of Good Hope species, from which however the author suggests that the American species may differ generally. However that may be, we urgently protest against this suppression of the old Gronovian and Linnæan genus, DIANTHERA, which was founded upon our species; and which name, although unaccountably overlooked by Endlicher, who is usually careful, as well as by Nees, who is careless, as to questions of priority, must surely be con-

tinued for the genus, however bounded, which includes the Justicia pedunculosa and J. humilis of *Michx.*

The remainder of the volume, contributed by Schauer of Breslau, comprises first, *Phrymaceæ*, another of those inconvenient little orders established on a single genus of a single species, which however, differs remarkably from Verbenaceæ as well as Labiatæ, by the monomerous ovary, with a single orthotropous ovule erect from the base of the cell, an embryo with the radicle superior, and convolute cotyledons; and finally, the *Verbenaceæ*, composed of three tribes, (the *Verbeneæ*, *Viteæ*, *Avicennieæ*,) ten subtribes, and forty-two genera. The genus Verbena, with which we are principally concerned in the United States, comprises seventy-one species, besides a dozen dubious ones appended at the close.

We had nearly forgotten the small family *Myoporaceæ*, which is elaborated by Prof. Alph. De Candolle himself. These twelve genera are all Australian or Oceanic, except Bontia, which is a Caribæan genus of a single species.

The twelfth volume, which will contain the *Labiatæ* by Bentham, is promised for June. A. Gr.

4. *Transactions of the Linnæan Society of London*, vol. xx, part 2d, 1847.—The first article is, "An Enumeration of the Plants of the Galapagos Archipelago, with Descriptions of those which are new," by Dr. J. D. Hooker, a paper full of botanical interest.* This is followed by another of still more general importance, "On the Vegetation of the Galapagos Archipelago, as compared with that of some other Tropical Islands and of the Continent of America," in which the same author has discussed with great ability, the various geographico-botanical questions which are presented by a flora of about 240 known species, more than half of which are peculiar to those islands, —"a peculiarity shared by no other tract of land of equal size, excepting, perhaps, the Sandwich group." And this flora, moreover, possesses the rare advantage of being one whose vegetation has never been interfered with by any aborigines of the human race, nor disturbed until recently, and to a very limited extent as yet, by the operations of man or of animals introduced by his agency. The results of the examination are, "that the relationship of the flora to that of the adjacent continent is a double one, the peculiar or new species, being, for the most part, allied to plants of the cooler parts of America, or the uplands of the tropical latitudes, whilst the non-peculiar are the same as abound chiefly in the hot and damper regions, as the West Indian Islands and the shores of the Gulf of Mexico; also that, as is the case with the Fauna, many of the species, and these the most remarkable, are confined to one islet of the group, and often represented in others by similar, but specifically very distinct congeners." The analogous distribution of the Fauna in the various islets of the group was illustrated by Mr. Darwin, as our scientific readers are aware. "This examination," Dr. Hooker proceeds to remark, "has led me to take a sur-

* The *Entriana affinis*, Hook., fil., p. 174, note, from the United States, is doubtless the same as the *Atheropogon papillosus*, Engelm., published in this Journal for January, 1844.

vey of several other tropical islands, whose plants present much peculiarity, and to trace the effects of isolation in geographical position upon vegetation, as well as certain characters in some orders, their distribution and proportions, which seem to distinguish insular floras from the continental." The topics so ably discussed possess such general interest as well as novelty, that it appears very desirable to reprint the whole article in this Journal, if room can be found for it.—The next article is "On the Ambrosinia ciliata of Roxburgh (Cryptocoryne, Fischer)," by the lamented Mr. Griffith, with three plates. The most remarkable peculiarity here illustrated, appears to be the spontaneous separation, in the seed of this aquatic plant, of the fleshy cotyledon, which fills the cavity of the nucleus, from the highly developed and complex plumule, which is thus detached long antecedently to proper germination so as to form an independent plantlet. The whole seems to be quite analogous to what takes place at germination in those monocotyledons, whose cotyledon remains nearly unchanged within the seed, and at length separates from the growing plantlet.

There are two brief botanical contributions by Dr. Falconer, one "On the Assafœtida plant of Central Asia;" the other an "Account of Gamoplexis, an undescribed genus of Orchideous Plants." "It appears to be a true parasite, but after a peculiar fashion which disguises the habit. The tuberous rhizoma emits no root-fibres by which to fix itself on other plants, but is itself matted over by their slender rootlets, which ramify upon it in every direction, slightly imbedded in its surface, to which they adhere with great tenacity, giving rise to the appearance of the plant, being the subject of a parasitical growth rather than a parasite itself. Its name indicates the principal peculiarity of the floral structure, namely, the union of all the parts of both whorls of the envelops into a completely monophyllous perianthium."—The remaining articles are entomological, and all contributed by Mr. Newport, namely, "On the aqueous vapor expelled from bee-hives;" "On the generation of the Aphides;" and an elaborate memoir, the first of the series, "On the Natural History, Anatomy and Development of the Oil-beetle, Meloe," a genus of insects which appear to exist in the early period of their life as parasites, while in the latter stage they are purely herbivorous. A. Gr.

5. *A Synopsis of the Lichenes of New England, the other Northern States, and British America;* by Edward Tuckerman, A.M., etc. Cambridge. G. Nichols. 1848. p. 93, 8vo.—This is a separate issue, with a preface and some emendation, of an article contributed to the Proceedings of the American Academy of Arts and Sciences, which is of sufficient fullness to make a substantive volume by itself. In its publication, Mr. Tuckerman has supplied a great desideratum, by placing in the hands of our botanists good descriptions of all our Lichenes, according to the classification of the distinguished Fries, and in the English language. He has, in fact, opened a new department of the vegetable creation to our botanical students, from which they have till now been entirely excluded by the want of any accessible and adequate treatise; and we may expect that our Lichenes, as well as the Mosses and Liverworts (which Mr. Sullivant has in like manner rendered accessible) will soon be popular objects of study, and become

at least as familiarly known as our Grasses and Sedges. Indeed, the Lichens will be found to be much easier than the Mosses, since they require less of microscopical investigation for their determination. We presume, therefore, that the small separate edition of this useful work will soon be sold off, that the collections and researches it must incite will bring to light new materials, and that a new edition will be required in a year or two, which we venture to think would more directly subserve the end in view if cast in a much more popular form. The advancement of science, in any of its departments, demands the efforts and contributions of many hands. To promote the desired results as respects the Lichenes, we venture to ask botanists throughout our country to collect these neglected plants, and largely to contribute their materials, especially the rare and doubtful forms, to our American Lichenologist. A. Gr.

6. *A Flora of Maine, illustrated with specimens from Nature, arranged according to the Natural System, and containing Descriptions of all the known Indigenous Plants growing in the State, etc.;* by Aaron Young, Jr. Bangor. 1848. Vol. i.—We have seen a specimen volume of this work, which Mr. Young, who was recently appointed to make a botanical survey of the state of Maine, is engaged in publishing, "in so unique a manner." It is a large folio volume, very handsomely bound in cloth, and containing fair specimens of about forty plants of the state, each fastened to a sheet of thick paper, protected by a fly leaf, and accompanied by another leaf containing the name of the natural family to which the species belongs, its generic, specific, and popular names, a specific character, place of growth, time of flowering, and some descriptive or popular remarks. Mr. Young proposes to publish all the plants of his state in this manner, "in about twenty volumes" (which, however, will not be sufficient for the purpose), and offers the whole to subscribers for $100, or the volumes, "of from five to ten decades each," at six dollars. No doubt there will be a ready demand for as many copies as he can prepare, "of the present magnificent size" and style; but how they can be afforded at this price is entirely beyond our comprehension. That it is not done at the expense of the state, but at the author's proper expense, is evident from the fact, that, the appropriation for conducting the botanical survey appears to be only two hundred dollars per annum for three years. A. Gr.

7. *Ledebour, Flora Rossica*, fasc. 8, (1847).—This fasciculus commences the third volume of a work which we have already noticed from time to time, during its progress. We have now barely room to state that it is continued with the same perseverance, faithfulness and ability; and that the present portion contains the Lentibularieæ, Primulaceæ, Aquifoliaceæ, Ebenaceæ, Oleaceæ, Jasmineæ, Apocynaceæ, Asclepiadeæ, Gentianaceæ, Polemoniaceæ, Diapensiaceæ, Convolvulaceæ, Borragineæ, Hydroleaceæ, Solanaceæ, and a large part of the Scrophulariaceæ, of the Russian Empire. The Cuscuteæ are kept back, for the present, to await the appearance of Dr. Engelmann's Monograph of that group. A. Gr.

8. Hooker's *London Journal of Botany*, begins the new year (and No. 73) with new publishers, namely, the Messrs. Reeve, who at present appear to be the most extensive and enterprising publishers of works

on Natural History in Great Britain. The first article of the number is an admirable exposition of the *Structure of Cruciferous Flowers*, by Moquin-Tandon and Webb. The most novel point in this essay, is the application of the doctrine of *deduplication** to explain the departure from symmetry presented by the tetradynamy of the stamens. Their view, that the two pairs of long stamens, which stand opposite the anterior and posterior sepals respectively, represent each a single organ which has been subject to *dedoublement*, is convincingly maintained by many arguments. Before the article reached this country, the writer of this notice had suggested and written out for the press, a similar explanation of the anomalous andrœcium of Fumariaceæ, in which case the original stamen is trebled, instead of doubled. In their exposition of the structure of the fruit in Cruciferæ, especially as to the position of the stigmas, our authors, without being aware of it until their article was sent to press, have exactly reproduced the ideas of Robert Brown with respect to the nature and composition of the stigma, and its relation to the placentæ,—views which have been well known in this country ever since their publication, or at least, should be so, as they were incorporated into a common elementary work in 1842. But the observations of Mr. Brown upon this point, seem not to have attracted the attention in Europe which they so eminently deserve. Indeed, the same remark may be extended to the whole of that elaborate note, in Bennett's *Plantæ Javanicæ Rariores*, in which Mr. Brown discusses, with his accustomed terseness, the most interesting questions of structural botany, and which constitutes unquestionably the most important contribution to botanical science which has been made in recent times.

The next article is a continuation of Mr. Miers' *Contributions to the Botany of South America*, giving a critical account of a new monopetalous genus, *Sclerophylax*, of uncertain family. Mr. Wilson contributes the characters of three new Australian mosses; of which figures are given. Under the head of Botanical Information, we are favored with a highly interesting notice of a scientific mission to Thibet, now in progress, from which important results may be expected. The botanist of the expedition is Dr. Thomas Thomson, a son of the distinguished chemist of Glasgow, whose letters give a lively sketch of the journey from Simla to Dakur, in the Himalayas; and a note, which the editor appends, apprises us of the safe arrival of the party, at the close of September last, at Giak, a town only five days journey from Leh (or Ladakh), the civil capital of Thibet.

From the *Ratisbon Flora*, is given a translation of Dr. Sendtner's account of his botanical visit to Bosnia, which has been unfortunate, Dr. Sendtner having been attacked by a Bosniak, while botanizing, and severely wounded, so that he barely escaped with his life. Fendler's Santa Fe collection is then noticed; as also is the recent rediscovery, by Dr. M'Fayden, of the Nelumbium Jamaicense in Jamaica,—a plant which was found by Dr. Patrick Browne nearly a century ago, but which had not since been seen. It turns out that this species is a true Nelumbium, nearly allied to our own North American N. luteum, if not the very same. A fuller account of the rediscovery is printed in the *Com-*

* See notice of Henfrey's Outlines, &c., vol. ii, ii ser., p. 444.

*panion to the Botanical Magazine* (for January), which is an extra sheet of botanical matter which has, for the last year or more, been added to the numbers of that well-known periodical. The notices of books give an account of the eleventh volume of De Candolle's Prodromus; of Sir Robert Schomburgk's *History of Barbadoes;* of Dr. Harvey's *Nereis Australis*,—a work which we hope to be able to notice in detail ere long; of Dr. J. D. Hooker's *Flora Antarctica* (of which we also speak in the present number); of Dr. Darlington's *Agricultural Botany*,—a small, but highly useful volume, marked by the characteristics of faithfulness and accuracy, and true devotion to science, which distinguish all his botanical writings, (of which volume we accidentally lost the opportunity of speaking at the proper time, but which we doubt not is commending itself to the attention of those for whom it was principally designed.) There is besides an enumeration of the contents of a new work by G. Rainey, (which we have not seen,) entitled, an Experimental *Inquiry into the cause of the ascent and descent of the Sap, with some observations on the nutrition of plants, and the cause of Exosmose and Endosmose;* and also of Mr. M'Ivor's *Hepaticæ Britannicæ, or Pocket Herbarium of British Hepaticæ*,—containing specimens of 135 species (or marked varieties) under 39 genera, put up in the same manner as the Musci Britannici of Mr. Gardner, (price £1 1*s.*) Such a collection would doubtless be in demand in this country, where the Hepaticæ are just beginning to attract attention.

Since writing the above, we have received the numbers of this Journal for February and March, which were published together on the first of March. Mr. Miers continues his *Contributions to the Botany of South America*, concluding his remarks on *Sclerophylax* and *Sclerophylaceæ;* and also describes another genus, *Cyphocarpus*, of abnormal characters, related to Campanulaceæ and Goodenciaceæ. The elaborate *Prodromus Monographiæ Ficuum*, by Prof. Miquel, is continued, some new genera established, and many new species described.

Mr. Gardner, now the Superintendent of the Royal Botanic Gardens in Ceylon, continues his *Contributions towards a Flora of Brazil*, consisting of some Asteroid Compositæ. A figure and description of *Aulacopilum, a new genus of mosses from New Zealand*, is given by Wm. Wilson of Warrington; who also contributes "*Further Remarks on the pollen-collectors of Campanula, and on the mode of fecundation;*" the larger part of which we extract, as follows:

"Five years ago I presented to the readers of this Journal, the result of my early studies of this genus, (see vol. i, p. 601,) and I have now to acknowledge that I was led by the appearances which I observed, into the erroneous conclusion, that the pollen-grains obtain access to the interior of the collecting-hairs by virtue of some peculiar function exercised by these organs. Very soon after the publication of my paper, I became doubtful of the validity of the inference I had drawn from innumerable examples; and in the following season, having had recourse to the test of examination of the pollen-collectors previous to dissection, I could no longer withstand the conviction that the introduction of pollen-grains within the hairs, does not take place until an avenue is artificially opened by means of the dissecting knife; and that

all the numerous cases of introduction which I had witnessed, were owing to the facility with which the grains enter the hairs at the moment when the sections were made for microscopic scrutiny. I have now to state, by way of apology, that the inference, though an erroneous one, was not hastily made, and that the same inference has since been made by Dr. Hartig, and adopted by him as an important fact, in support of his new theory of the fertilization of plants, and more particularly of that part which treats of 'fertilization by means of the style.' The use which is made of the supposed fact in that work, impels me to delay no longer this retraction; and I am happy to state that a renewed examination of *Campanula rotundifolia* has supplied me with very satisfactory evidence, that the same mode of fecundation obtains in this genus, that it is observable in other plants, and that the doubts which I have long entertained as to the validity of Schleiden's theory, have at length been almost entirely removed. I shall now give the result of my recent investigation of this genus.

"The hairs which cover the upper part of the style, and the back or external face of each branch of the stigma, are simply *pollen-collectors* and nothing more: they discharge this function admirably; and having performed it, they retire, each within its own cell, by virtue (as I suppose) of some action of exosmosis, operating in conjunction with an opposite action of endosmosis, on the part of stigmatic tissue, the effect of both which actions is to produce the revolution of the branches of the stigma, (which until then are erect and in mutual contact and cohesion,) and to remove every obstacle which would prevent the revolute stigma from coming into contact with the mass of pollen lodged upon the style. The withdrawal of fluid from the interior of the pollen-collector, will necessarily cause the fine inner membrane to shrink; it is thereby shortened, and acting with tension on the external membrane of the hair, which is elastic and somewhat horny, the latter is drawn inwards, as the sliding tubes of a telescope are made to retire into each other, until the whole of the exserted hair is retracted into its base, which forms an embedded cavity in the substance of the style. An interval of at least a day, perhaps two days, may exist between the moment of dislodgement of the pollen from the anthers, and its ultimate deposition on the stigmatic papille. The pollen is emitted from the anthers when the flower is just opening; at this moment the anthers form a tube around the style and stigma, the latter being scarcely protruded above the tube. As the flower advances, the style is elongated to nearly twice its original length, or more, before the branches of the stigma begin to roll backwards: this elongation causes the pollen to be brushed out of the anthers, and the pollen then adheres very copiously to the style and back of the stigma; but as yet not a single grain can touch the stigmatic papillæ. This can happen only after the branches of the stigma are separated from mutual contact. Previous to the revolution of the stigma, the pollen-collectors are retracted, those at the back of the stigma somewhat sooner than the rest; and by means of the revolution, the surface of the stigma is brought into close contact with the pollen-grains, a sufficient number of which are thus made to adhere to the stigmatic papillæ, and to produce pollen tubes. The pollinic tubes penetrate between the papillæ, and

between the stratum which they form and a layer of vascular tissue, into the tubular central cavity of the style, which forms a channel of communication with the placentæ. The course of the pollen tubes from the base of the style, is by a sudden bend upwards into the middle of each placenta, which presents two contiguous surfaces, and thence over the whole free external surface of the placentæ, to which the foramen of each ovule is closely applied. After fecundation, it is not a difficult task to dissect away the ovules with a considerable length of pollinic tube, whose anterior extremity is inserted into the foramen; nor should I, after what I have already accomplished, despair of dissecting away an unbroken pollen-tube uniting the pollen-grain with the penetrated ovule. Until my recent examination of *Campanula*, I had obtained no conclusive evidence (after much pains bestowed for that very object) that the pollen-tubes ever actually penetrated the ovule; and some of my observations already published, seemed to justify the rejection of much of what had been advanced by previous writers in favor of that opinion. But I have now no hesitation in admitting it as proved; and it only remains to inquire into the mode and extent of operation of the pollinic tube, after its introduction to the interior of the ovule.

"As a consequence of the theory of Schleiden, it is maintained by Wydler, that plants have not two sexes, as hitherto supposed; that the anther, far from being the male organ, is the female,—in fact, an ovary; that the pollen-grain is the germ of a new plant; that the pollinic tube becomes the embryo within the embryo-sac of the ovule, which merely supplies nourishment and shelter to the embryo up to a certain period; and that this phenomenon is improperly termed 'fecundation.'

"It is, on the contrary, asserted by Mirbel and Spach, that the pistil fulfills an important function in generation, inasmuch as it originates of itself the primordial utricle, which, in conjunction with those utricles which it produces, gives birth to the embryo; and they conclude that phylologists are right in admitting the fecundation of plants, and in assimilating it, up to a certain point, to that of animals. They contend that the embryo-sac, as understood by Schleiden, has no real existence; and that the *utricule primordiale*, although it gives rise to the embryo, is not formed of the anterior extremity of the pollen-tube, though it would remain inert if fecundation by means of the pollen did not take place. They explain their views of fecundation by reference to the process of grafting, the cambium introduced by the pollen-tube becoming intimately blended with the cambium of the *utricule primordiale*; and according to the mode and degree of combination may be explained the formation of hybrids, some of which show the character of the male parent, others of the female, and others a mixture of the characters of both the parents.

"The argument seems upon the issue of the debated question whether the primordial utricle has a prior existence within the ovule, independent of the action of the ovule. It will be advantageous to reject Schleiden's figment of introverted embryo-sac, and to substitute the simple idea of an embryonary cavity within the nucleus, prepared for the reception of an embryo. M. Ad. Brongniart contends that 'in several plants, and particularly in the *Cucurbitaceæ*, he has ascertained

that the *vésicule embryonaire*, considered by Schleiden to be formed of the extremity of the pollinic tube, exists in the ovule before fecundation.' I can not confirm this statement as to the *Cucurbitaceæ*, where I find only an embryonary cavity, but no contained vesicle. In *Zea Mays*, an example prominently adduced by Mirbel and Spach in proof of their position, I find, indeed, the organ which they designate as the *utricule primordiale;* but I recognize in it only the *quintine*, analogous to that of *Nuphar lutea*, but not extending farther than the middle of the nucleus, and of peculiar conformation. After repeated dissections, most carefully conducted, I am unable to detect the smallest trace of a suspensor like that figured by Mirbel and Spach, (Annales des Sciences Naturelles, April, 1839,) and the 'grappe de très petiets utricules ovoides qui courronent l'utricule primordiale' is not correctly represented in the plate (figs. 11, 13, 15); it consists of larger and fewer cellules, by no means pendulous, but forming a conglomerate opaque mass, of an ovate oblong figure, which appears to be intimately connected with a central canal in the interior of the 'utricule primordiale,' communicating with one or more roundish or oblong bodies (within the utricule) at the opposite extremity, where the supposed suspensor should be visible, if it existed. The contents of the 'utricule' [or quintine] cannot be satisfactorily ascertained beyond this point, by reason of their extremely delicate structure, the least pressure causing a displacement of the loose particles (termed *cambium globulo-cellulaire* by Mirbel and Spach) and a movement along the central canal; moreover, the parts are soon ruptured or greatly altered in appearance by endosmosis, while the dissection is under examination in water. It appears to me that neither Schleiden nor Mirbel and Spach have rightly interpreted the organ under consideration, and that nothing positive has been advanced on either side of the question." (p. 92—96.

Further particulars of the scientific mission to Thibet are given in additional letters from Dr. Thos. Thomson. Among the *Notices of Books* there is a pretty severe one upon the *Botanische Bemerkungen*, etc., of Presl, in which it is not difficult to recognize the able pen of an eminent English botanist. Nor should we neglect to state that the *Synopsis Hepaticarum*, by Gottsche, Lindenberg, and Nees v. Esenbeck, is brought to a close, forming a thick volume of upwards of 800 pages, and a supplement of no less than 181 pages, containing the recent additions to this family. The authors divide the Hepaticæ into five tribes and seventy-two genera!

In the March No., Mr. Bentham's *Contributions to the Flora of Guiana*,—to which he now gives a more general character, and includes all the species known as natives of Guiana, (instead of restricting himself to Schomburgk's collections,)—is devoted to the Malpighiaceæ. We are next treated to the first part of a very interesting journal of a tour in the United States, viz. *Notes* and Observations on the Botany, Weather, &c. made during a tour in that country, in 1846 and 1847, by Dr. Broomfield. The lively remarks of such an acute and practised observer will be read with attention in this country, especially by those who were so fortunate as to enjoy his acquaintance here. We grieve to meet with a notice of the death of Dr. Thos. Taylor, the well-known Muscologist and Lichenologist, of Ireland. But we rejoice to

notice the appointment of the accomplished Dr. Haney to the chair of Botany in the Dublin Institution; an appointment, however, which will not require him to relinquish the care of the herbarium of Trinity College, which he has so successfully created, nor interrupt the regular monthly publication of the admirable *Phicologia Britannica*, of which we some time ago received the 25th number, (for January, 1848,) containing plates 145 to 150. A. Gr.

9. *Illustrations conchyliologiques, ou description et figures de toutes les Coquilles connues, etc.;* par M. Chenu, M.D.—This is a magnificent illustrated work in large folio, the size of the plates and text being fourteen by twenty inches, the latter printed in double columns, and containing a complete history of each genus. The plates admit of a large number of figures, so that varieties of allied species can be readily compared, whilst the large species can be figured the full size, as in the case of *Cassis* and *Strombus gigas;* the latter is figured from an unusually large and perfect individual, and in addition, two figures of the mollusc are given.

The plates are well engraved on copper and colored in the best manner, except those of the fossil species, which are executed in a good style of lithography, like d'Orbigny's palæontological works. Among the more beautiful of the plates, attention may be called to those of *Spondylus* and *Pecten*, which are figured from very perfect specimens. An example of the mollusc is usually figured, and in some cases extended anatomical details are given. Various authors, including Caillaud, Duclos, Petit, Récluz, Valenciennes, &c., have contributed to various portions. Among the genera treated by Dr. Chenu himself, may be mentioned *Spirorbis*, *Aspergillum*, *Dentalium*, *Corbis*, and *Pecten*. The genus *Panopea*, by M. Valenciennes, extends to twelve plates with eight pages of text; *Sigaretus*, by M. Récluz has four plates and twenty-four pages of text; and twenty species of *Aspergillum* are described, of which fifteen are new.

Latterly, published figures have been copied pretty freely, including a number of Mr. Lea's species of *Unio*, from the Am. Phil. Trans., which is to be regretted, since many of these were drawn from small and imperfect examples. The five plates of Haldeman's monograph of *Physa* are copied upon one plate, but the execution is not quite equal to that of the original. Dr. Chenu copies Mr. Lea's figure of "*Siliquaria claibornensis*" taken from a fragment, when a much more satisfactory one was at hand in Mr. Conrad's figure of his "*S. vitis.*"

The very extensive genus *Helix* has been recently commenced, and among the latest plates (the text not having yet appeared) are five devoted to the American fluviatile genus *Anculosa* of Say, under Rafinesque's prior name of *Leptoxis*, well known as presenting an unusual number of varieties. These are fully represented, L. prærosa, *Say*, (for which *Haldeman* is incorrectly cited,) having eighteen figures, including two of the mollusc. Fig. 27 to 34 represent L. obovata, *Say;* and 35 to 39, L. plicata, *Conrad*, although by an error in the lettering, the latter is made to include from fig. 30 to 39. The protean L. dissimilis, *Say*, has seventeen figures, and L. dilatata, *Con.*, has thirteen. The five plates illustrating twenty-eight species, contain about one hundred and seventy figures. Mr. Lea's *tuberculata* is united to Con-

rad's *plicata*, and *flammata* to *picta;* whilst *rubiginosa* and *griffithiana* of the former author are considered identical. In the same manner Mr. Anthony's *costata* is figured under Say's *trilineata.*

The price of the work is 22½ francs a number, of five plates with some letter-press; which is quite reasonable, considering the number of species figured, and the splendid style of the work. In the later numbers, six plates have been given without any augmentation of price. The work was commenced in 1843, and has appeared regularly and rapidly to the present period.

A. Gray and I. Sprague: Genera Floræ Americæ Boreali-orientalis Illustrata.—The Genera of the Plants of the United States, illustrated by figures and analyses from nature by Isaac Sprague, Mem. Bost. Nat. Hist. Soc., superintended, and with descriptions, &c., by Asa Gray, M.D., Fisher Professor of Nat. Hist. in Harvard University. Vol. i, plates 1–100. *Boston*, James Munroe & Company, 1848.

Report, No. 470, House of Representatives, April 13, 1848: on a proposed Government expedition to a southern point, to observe on the planet Venus, during her retrograde motion.

Golding Bird, A.M., M.D., F.R.S.: Elements of Natural Philosophy, being an experimental introduction to the study of the physical sciences, with three hundred and seventy-two illustrations: from the revised and enlarged third London edition. 412 pp. 12mo. *Philadelphia*, Lea & Blanchard.

J. Mayne, M.D., L.R.C.S.: A Dispensatory and Therapeutical Remembrancer, comprising the entire lists of Materia Medica preparations and compounds, with a full and distinct version of every Practical Formula, &c.; revised with the additions of the Formulæ of the United States, by R. Eglesfield Griffith, M.D. 330 pp. 12mo. *Philadelphia*, 1848. Lea & Blanchard.

Julius Wiesbach: Principles of the Mechanics of Machinery and Engineering; First American Edition, edited by Walter R. Johnson, A.M., Civ. and Min. Eng. 2 vols.—Vol. I. Theoretical Mechanics. pp. 488. *Philadelphia*, 1848. Lea & Blanchard.

C. Gould: Companion to the Microscope; 15th edit., revised, 12mo, pp. 70, with plates. *London.* 2*s.* 6*d.*

The Bass Rock; its Civic and Ecclesiastical History, by Thos. M'Crie, D.D.; its Geology, by Hugh Miller; its Martyrology, by Rev. Jas. Anderson; its Zoology, by Prof. Fleming; its Botany, by Prof. Balfour. Post 8vo, pp. 584, cloth. 10*s.*

J. H. Morgan and J. T. Barber: An account of the Aurora Borealis of October 21, 1847, together with others of the same year, and one of March 19, 1846, seen at Cambridge. Imp. 8vo, pp. 26, with 12 colored illustrations. Sewed. 5*s.*

A. von Humboldt: Cosmos, translated by Lieut. Col. Sabine, R.A.; vol. ii, complete. *London.* pp. 508. Cloth. 12*s.*

Proc. Bost. Soc. Nat. Hist.—Oct. 6, 1847. p. 251, Descriptions of Shells of the Exploring Expedition (species of Bulla 1, Tornatella 1, Haliotis 1, Scalaria 2, Littorina 1); *A. A. Gould.*—*Oct.* 20, p. 254, Remarks on an arborescent Yucca; *J. E. Teschemacher.*—p 257, *Nov.* 3, Comparison of Sterna acuflavida and S. cantiaca, and description of a new Wren; *Dr. Cabot.*—p. 261, Remark on the Singing Mouse; *Dr. Abbot.*—p. 262, *Dec.* 1, Physa venosa and Pupa decora, new species from Lake Superior, and Natica fossata from Florida; *A. A. Gould.*

Proc. Acad. Nat. Sci. Philad., vol. iv, No. 1, *Jan.* 11, 1848, p. 1, On the existence of eyes in the Cirripeda; *J. Leidy.*—Dr. Leidy detects the eyes on the dark purple membrane lining the shell, on each side of the anterior middle line. The eye appeared as a small, round, black body, surrounded by a colorless ring or space of the membrane. The lens, pigment, and nervous filament were distinguished, and the nerve was traced to the supra-œsophagial ganglion.—*Feb.* 8, p. 4, Remarks on the Zeuglodon; *Agassiz.*—p. 5, Remarks on the Capillary glass of Kilauea; *S. S. Haldeman.*—p. 5, On a Hottentot; *S. G. Morton.*—On the cleavage of the calc spar of Rossie; *Mr. Ashmead.*—*Feb.* 29, p. 7, Descriptions of plants collected by W. Gambel in the Rocky Mountains and Upper California; *J. Nuttall.*—p. 26, Descriptions of new species of Cyanocorax (C. Harrisii and C. concolor, from South America); *J. Cassin.*—p. 27, On some bodies in the Boa constricta, resembling the Pacinian corpuscles; *J. Leidy.*

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